APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER | Air Circuits • Electrical Controls

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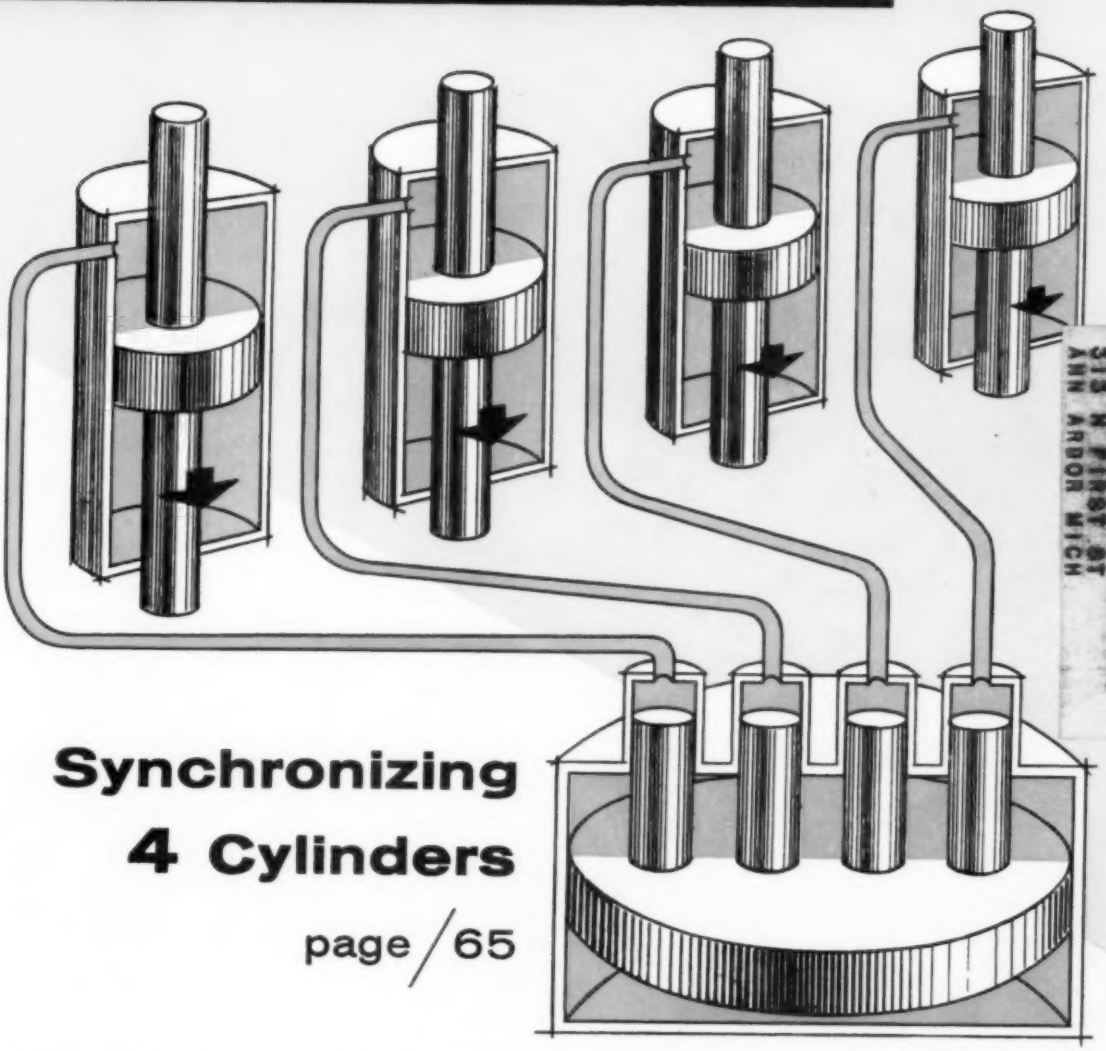
APRIL 1957



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page/65

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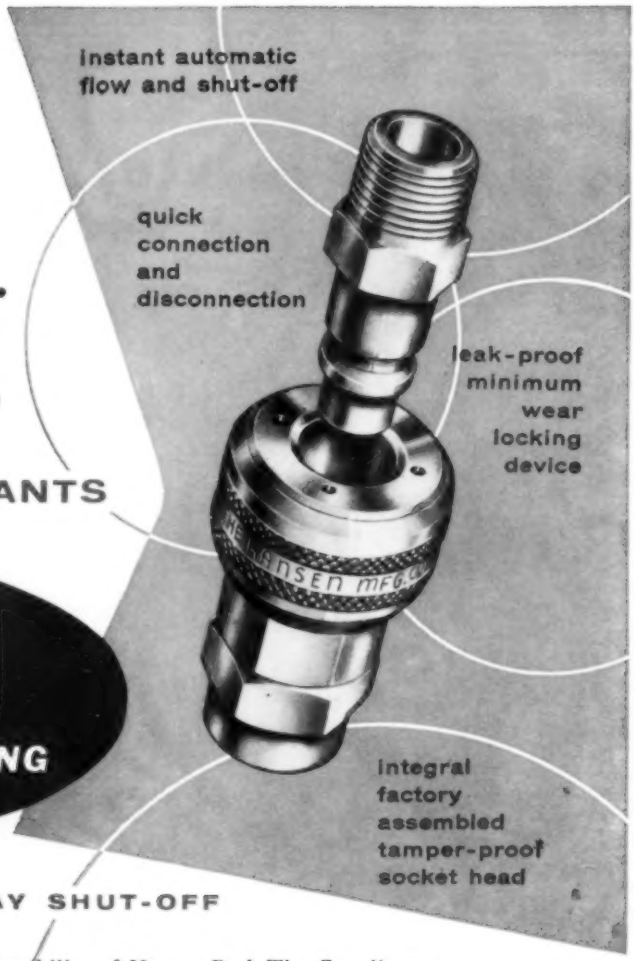
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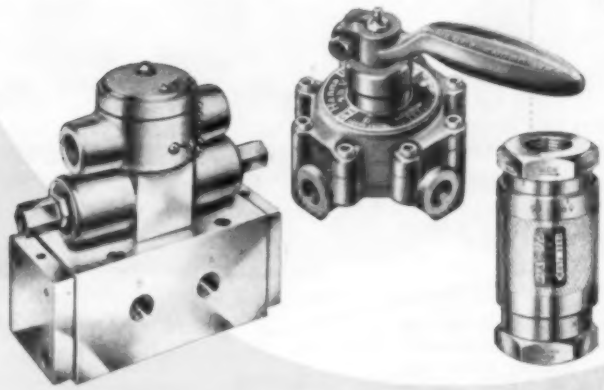

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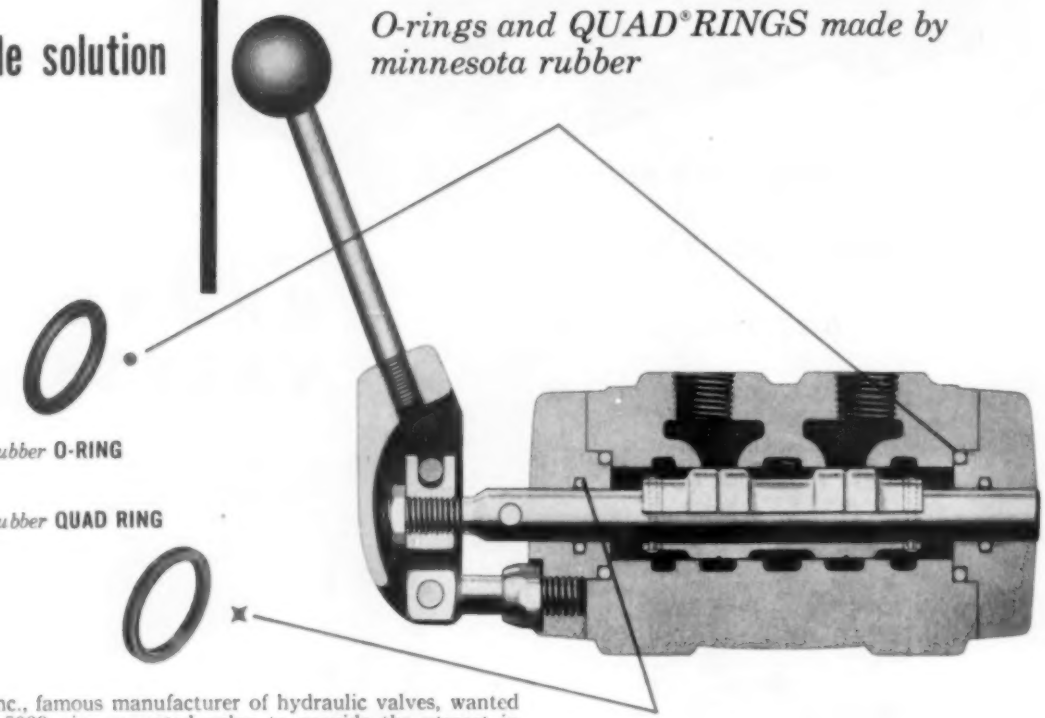

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HYDRAULICS
THE MAGAZINE OF FLUID POWER

APRIL 1957 • VOLUME 10, NO. 4

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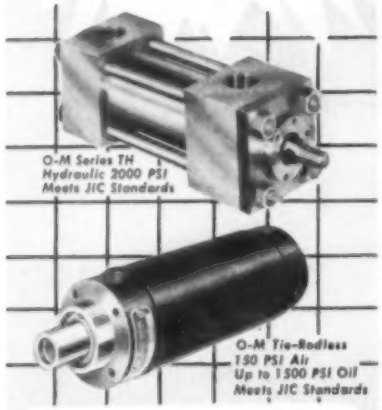

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BPA

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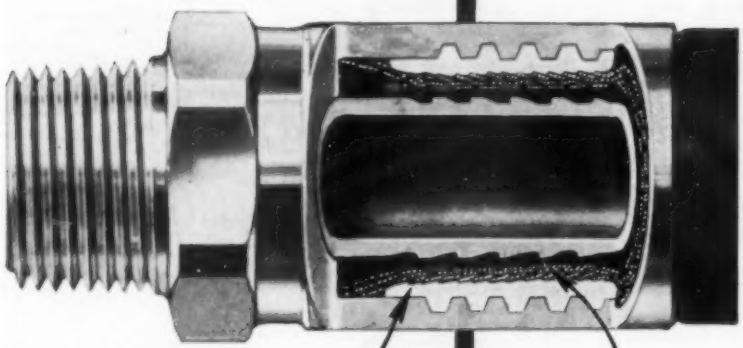

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You will find the wealth of engineering data included in the following catalogs extremely helpful. Write for them today!

Catalog No. 202 — Anchor Adapter Unions, Pipe Fittings and the new SAE Boss Type Adapters — See standards, Page 825, 1956 SAE Handbook.

Catalog No. 301 — Anchor Reusable Couplings.

Catalog No. 401 — Anchor FLANCO Split-Flange Couplings which conform to SAE Standards, Page 823, 1956 SAE Handbook.

ANCHOR COUPLING CO. INC.

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Useful Literature

New Condensed Catalog Covers Anchor Line

Users and manufacturers of hydraulic equipment, will find the new Anchor Condensed Catalog No. 57-S a most valuable adjunct to their engineering or maintenance files.

It contains a condensed, yet very complete presentation of the Anchor Line of Hydraulic Hose Assemblies, Couplings and Fittings. The Anchor Line is so reviewed as to greatly simplify selection of the correct Hose Assembly, Coupling or Fitting for any given application.

Included in this catalog are descriptions of the most standard Anchor Products, including Anchor Ductile Sleeve Couplings and other permanently applied Couplings with 2-Wire Braid Hose for high pressures, and with 1-Wire Braid. Hi-Burst 2-Rayon Braid, or Spiral Wire Braid for medium and low pressures.

Also described are Anchor Reusable Couplings which include the commercial Duloc Couplings for QW and QWR Hose and Anchor Standard Reusable Couplings with 2-Wire Braid Hose for high pressures, with 1-Wire Braid Hose, Hi-Burst and Standard 2-Rayon Braid Hose for medium and low pressures.

Anchor FLANCO 4-Bolt Split Flange "O"-Ring Couplings and Clamp-Type Hose Couplings for quick, easy emergency repair are listed.

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Also shown are the new Anchor SAE Adapters and Fittings designed to SAE Straight Thread "O"-Ring Boss standards, which are carried in stock.

This new condensed catalog of Anchor standard stock products is now available on written request. Write Anchor Coupling Co. Inc., 345 North Fourth Street, Libertyville, Illinois and ask for Catalog No. 57-S.

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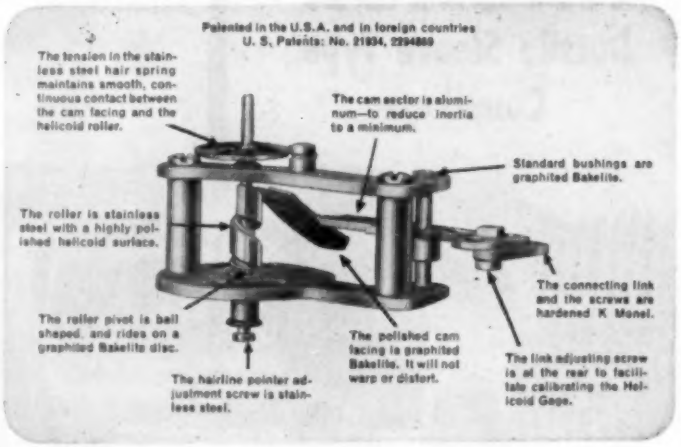
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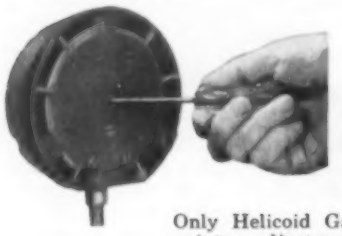

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Only Helicoid Gages have the external pointer adjustment pictured here. The Helicoid type adjustment cannot be jarred out of position.

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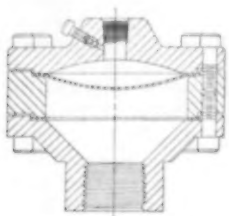

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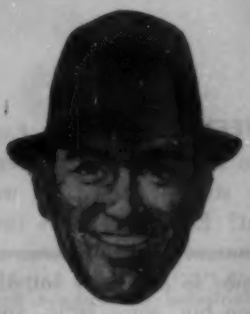

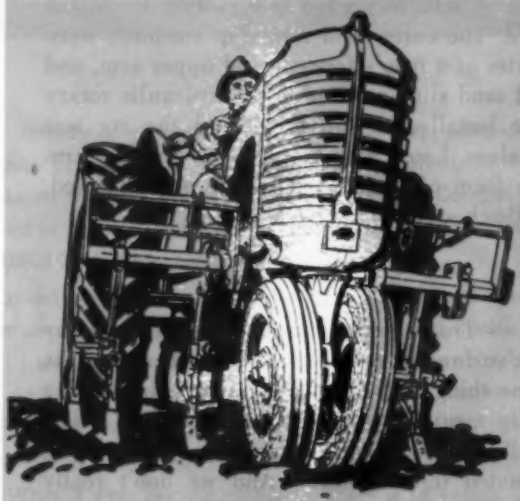

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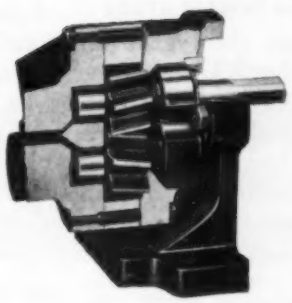

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Fluid Power Lines

about Applied Hydraulics

SWEETER MUSIC . . . Ever look into a piano and wonder at all the strings going this way and that? Each one needs two holes to mount it to the frame, and that comes to a mighty lot of holes: some big, some little, and some fair-to-middlin'. To drill them all at once takes a lot of force, and that means a job for hydraulics. That old bugaboo, *Synchronization*, steps in when we consider the uneven loading on the multiple drill head. Like most of us, pressure oil takes the path of least resistance, and when cylinders are connected in parallel, the lightest loaded one tends to move the fastest. One of the basic methods of making sure that all cylinders move together is by connecting them in series. This usually works well when two cylinders are involved. With four, the problem is more complicated. The article on page 65 won fourth prize in the AH 1956 Prize Paper Contest and describes a modification of the series circuit that's making sweeter music in piano manufacturing.

ELIMINATE A PUMP . . . One of our British contributors, J. R. Fawcett, teaches a lesson in economy in the article, *Simple Prefill System*. Using a pressurized tank as an accumulator, he shows how to obtain fast approach and high pressure squeeze with a single fixed displacement pump.

THE LONG ARM . . . Way back in the ancestry of the sand ramming machine described on page 68 there was a man pounding sand into a mold with a wooden mallet. He followed a certain pattern to get the best casting from that particular mold. The early sand ramming machines were simply duplicates of a man's forearm and upper arm, and had a powered sand slinging head. Then hydraulic rotary actuators were installed at the joints and the rig was "driven" by valves. Latest step has been to give the arm a brain in the form of programmed cams and a closed, hydraulic feedback system.

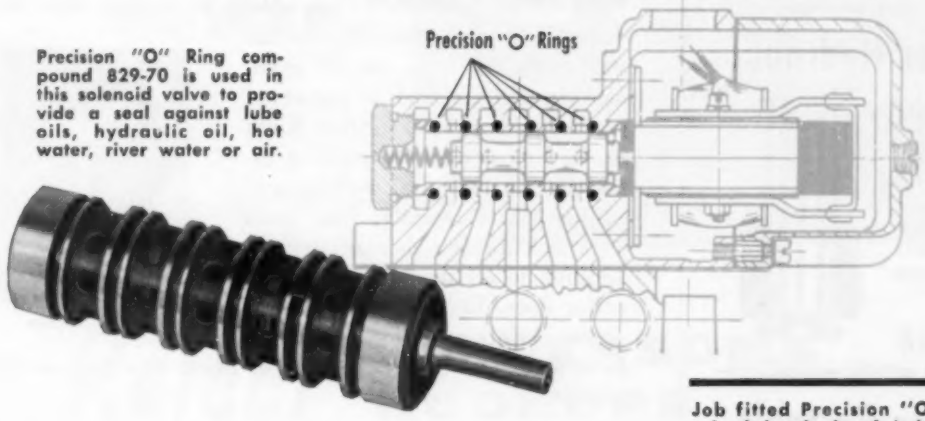
SILK PURSE . . . *Tracer* can mean many things to many people. If you've forgotten about a few payments on the TV set, it's one thing. If you're designing a duplicating lathe, it usually means a special component. The article on page 106 tells how a standard 4-way valve was modified as a cam actuated tracer control. And we don't really think standard components are sow's ears!

HIGH TEMPERATURE . . . Aviation people are really concerned about getting hydraulic and pneumatic devices which will operate at temperatures in excess of 500 degrees F. The component supplier has the problem of setting up equipment on which he can test his components at these high temperatures. General Electric has done a lot of work in this area. L. H. Smith describes their equipment in the Aviation Section.

COMPOUND 829-70

Versatile PRECISION "O" RING fills sealing requirement in dozens of industrial products

Precision "O" Ring compound 829-70 is used in this solenoid valve to provide a seal against lube oils, hydraulic oil, hot water, river water or air.



Job fitted Precision "O" Rings have solved hundreds of industrial, aircraft and automotive sealing problems.

Uniformity of size, excellent surface quality, compatability with a wide range of fluids . . . Numatics, Inc. of Milford, Michigan, cite these as reasons why "O" rings made from Precision Compound 829-70 are being used in their solenoid valves. They are giving service through more than 30,000,000 valving actions.

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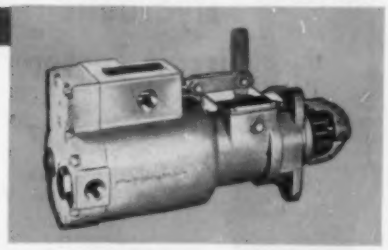
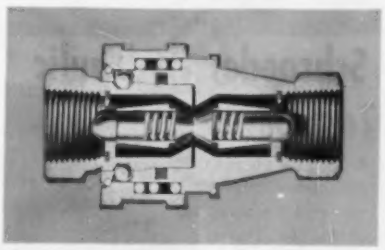
What is your sealing problem? There is an expert — the Precision engineer — ready to help you in product design and "O" ring specifications. You can rely on him — and on Precision, the world's largest exclusive producer of "O" Rings.



Precision "O" Rings were selected for this cranking motor after exhaustive tests for flexibility and sealing in arctic cold.



In this coupling, an "O" ring made from Precision Compound 829-70 seals against hydraulic fluids and pneumatics.

Write for your free copies of Precision catalogs on "O' Rings and Dyna-seals

Precision Rubber Products Corporation • "O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio

Canadian Plant at: Ste. Thérèse de Blainville, Québec

Circle 94 on Reader Service Card

Here's the SCHROEDER 3 way maintenance control system for IMPROVED HYDRAULIC OPERATION

1 REDUCE *the need for repair—*

Schroeder Hydraulic Filter Buggy

Removes troublesome dirt before it can gum up your hydraulic system. Saves oil, cuts pump and system repair costs.

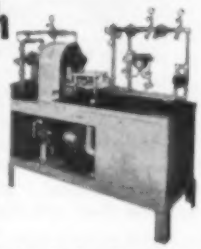
2 LOCATE *trouble at the machine—*

Schroeder Portable Hydraulic Circuit Tester

Does away with time-consuming hunting by quickly pinpointing the trouble spot before removing any component from the machine.

3 TEST *to prove repair—*

Schroeder Hydraulic Test Bench



Removes all guesswork—now you can be sure of the condition of each hydraulic component before it is returned to the machine.

For a smoother flowing hydraulic system use the Schroeder 3 way maintenance control system.

SCHROEDER BROTHERS CORPORATION

NICHOL AVE.
McKEES ROCKS, PA. SPaulding 1-4810
HYDRAULIC, ELECTRIC & PNEUMATIC EQUIPMENT

Fluid Power Lines

continued

MEET KEITH CARLSON . . . He'll be smiling when he calls. Keith joined the AH editorial staff early this year. An EE graduate from Case and a registered professional engineer in Ohio, Keith has had more than six years of experience in technical writing and editing—most recently, four years on *Machine Design* magazine. In addition to all the other things an editor does, Keith will concentrate on our Aviation Section. So, if you have any good ideas along these lines, he's the one to contact.

Keith Carlson

INAUDIBLE NOISE . . . In the jargon of the practitioners of the servo art, noise is not something you can hear. It's any undesirable input to the system controller. Noise in a servo system may result from vibration of feedback elements or imperfections in elements of the control system. When we encountered this not too familiar term in Paul Straight's article, on selecting pumps and accumulators for hydraulic servo-mechanisms (page 74), it started us thinking that perhaps some definitions of a few of the terms appearing there which are somewhat peculiar to servo work might be in order. Here are a few more:

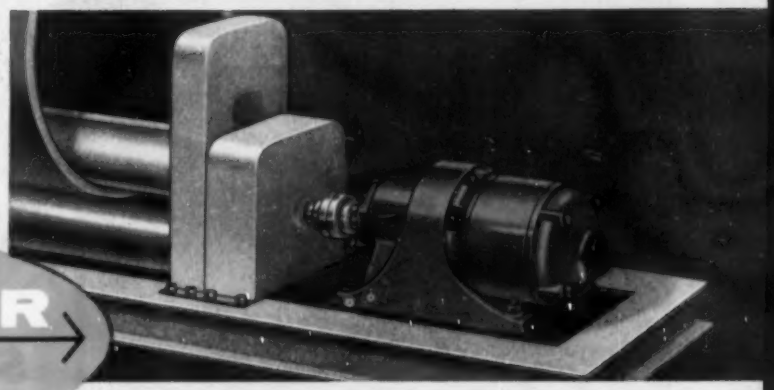
Program—The operating cycle or sequence of operations.
Saturated Velocity—Maximum velocity, or velocity at which system response is no longer linear with input.
Set Point—System condition corresponding to input or controller setting.
Steady State—Period when input signal and output load are constant.
Transient—Short period during which system input or load is changing.

BEST FOOT FORWARD . . . Editors of AH are aware of the limited time that design and production men have for reading technical magazines—even though these are an important part of their jobs. We are constantly trying to present ideas briefly and clearly using short headnotes to tell you what an article is about. Our latest innovation to save you time is the new Contents page. You'll find the articles grouped according to *Product Development, Circuit Analysis, Pneumatic Applications, Aviation, Electrical Controls,* and other classifications.

Circle 100 on Reader Service Card
Circle 123

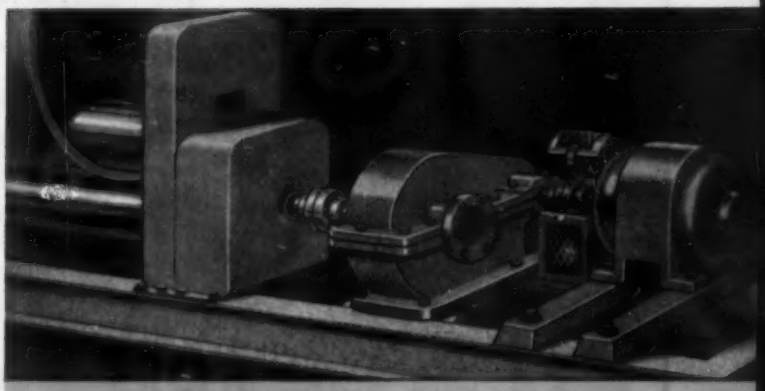
USE THE *Simplest* METHOD

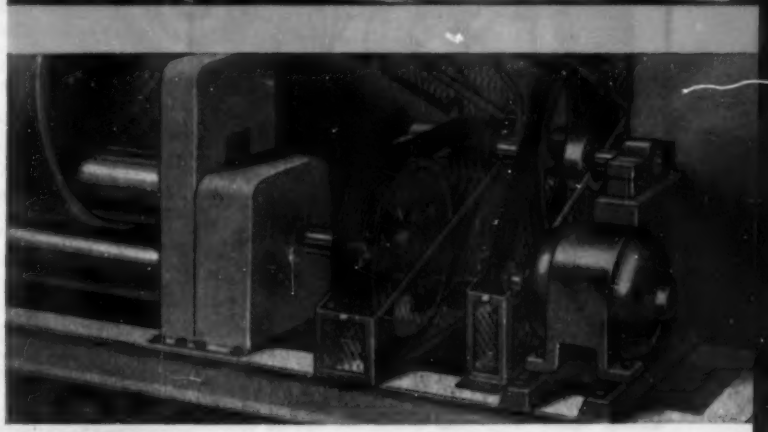
TO APPLY LOW SPEED POWER



SYNCROGEAR
THE INTERNALLY GEARED MOTOR

Reject CUMBERSOME HOOKUPS





The U. S. Syncrogear is more than a motor. Its "packaged" assembly includes a high speed motor, an enclosed sealed gear-train, correctly engineered for the load, always in exact alignment, all mounted in a single case which saves space and eliminates the ungainly appearance of complicated hookups. You don't have to calculate chain, sprocket, bearing or shaft requirements, or invest in separate mechanisms, special fabricated guards, extra pulleys and belting when you direct-connect a Syncrogear. More and more manufacturers are using Syncrogears on their products to improve appearance and increase saleability.

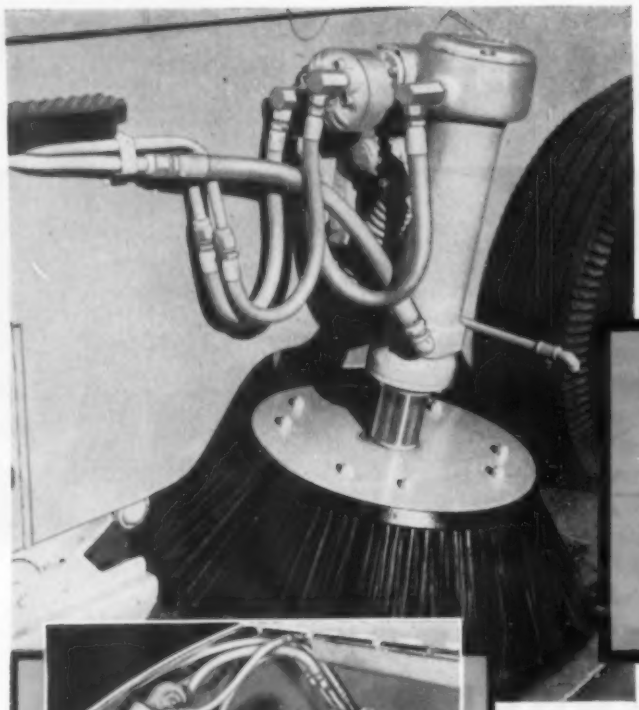
Free – Mail coupon for all new descriptive multicolor booklet with all the facts you should know about geared motors.

U.S. *Electrical* MOTORS

MAIL COUPON NOW

U. S. ELECTRICAL MOTORS Inc. AH-4
P.O. Box 2058, Los Angeles 54, Calif., or Milford, Conn.
☐ *Send Syncrogear Booklet*

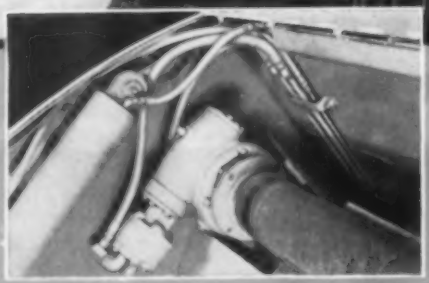
NAME_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____



THREE HYDRAULIC CONTROLS INCREASE BROOM LIFE:

1. Constant sweeping pressure maintained hydraulically with "floating" pressure, which compensates for any street irregularities.
2. Relief valve protects mechanism from curb damage.
3. Snubbing action eliminates bounce and undue wear to the broom.

HYDRAULICS IMPROVE SWEEPER PERFORMANCE



Two hydraulic circuits are used at maximum pressure of 1250 psi., supplied by direct driven pumps independent of vehicle drive.

Conveyor belt is driven hydraulically. Main broom floats under hydraulic pressure, with one lever controlling broom rotation, activating automatic belt training and conveyor belt rotation. Double acting hydraulic cylinders also open and close hopper.

Eastman—Elgin Engineering Staff Cooperate to Improve Efficiency and Service . . . Cut Manufacturing Costs

When Elgin Sweepers were converted to hydraulics, Elgin engineers enlisted the cooperation of Eastman engineers in the pilot application of Eastman Hydraulic Hose Assemblies.

The result of Elgin's conversion to hydraulics was more than an improvement in operating performance and efficiency—it resulted in space-saving economies which permitted dramatic improvements in streamlined design—as well as reduced manufacturing and maintenance costs.

Again, as in many instances in the past . . . Elgin, who pioneered the first successfully marketed sweeper in 1912 . . . turned to Eastman—who pioneered in the very first applications of Hydraulic Hose Assemblies. LEACH PACKMASTER, an associate Elgin product, is also an original Eastman user.

We invite you to write if you have a hydraulic conversion problem. We urge you to call upon our more than 40 years of experience—unequalled in the industry. Take advantage of our many original designs and advanced construction features. Enjoy the sales prestige of Eastman Hydraulic Hose Assemblies—*Standard of the Industry!*

Eastman
first in the field

MANUFACTURING COMPANY
DEPT. AH-4, MANITOWOC, WIS.

LETTERS
to the editor

Address your letters to: Editor, APPLIED HYDRAULICS Magazine, 812 Huron Rd., Cleveland 15, Ohio.

Synchronized Cylinders

In an application we are considering, a 100-foot long platform must be raised 12 inches by a battery of 11 cylinders. The problem is to synchronize the cylinders in a simple and economical manner. This machine would only operate for a short time during summer. It would be idle the rest of the year and exposed to very severe winter conditions. We would appreciate any information you can give us on this.

A. BOYD,
Project Engineer
Riverside Iron &
Engineering Works, Ltd.
Calgary, Alberta,
Canada

It should be possible to give the cylinders synchronized motion by merely hooking them up in series. That is, oil out of the rod end of one cylinder is sent into the bottom end of the next cylinder. For this set-up, the cylinders must be double-ended and have equal areas. Pressure requirements are of course an important factor in deciding if this hookup is practical. This series circuit method uses few components and will minimize your maintenance problem. You could do the job with one pump, one 4-way valve, and eleven series-connected cylinders. Your biggest unknown is what severe Canadian winter weather will do to the equipment. The matter of leaving the equipment idle and exposed to severe winter weather is quite critical. Perhaps you can work out some sort of protection.

JIC Standards

We would like to know where we can obtain copies of the JIC Standards for use in our Hydraulics Course in our Department of Industrial Education. Also, we would

Continued on next page

Low price and high quality make FULFLO Pressure Control Valves a natural choice for O.E.M. installation. The service they deliver . . . quiet, dependable, trouble-free . . . makes them ideal from the equipment users' viewpoint too! Available with "O" Ring or Gasket Seal.

- Standard and Flanged models
- Just 6 springs for pressures to 500#
- Cast iron or brass bodies
- Brass, steel or stainless pistons
- Pipe sizes to 2½"
- SPECIALS to your requirements

FULFLO

WRITE for "Fulflo Valves Mechanical Data Book," free helpful reference

THE FULFLO SPECIALTIES CO., Inc.

415 Fancy Ave. • Blanchester, Ohio

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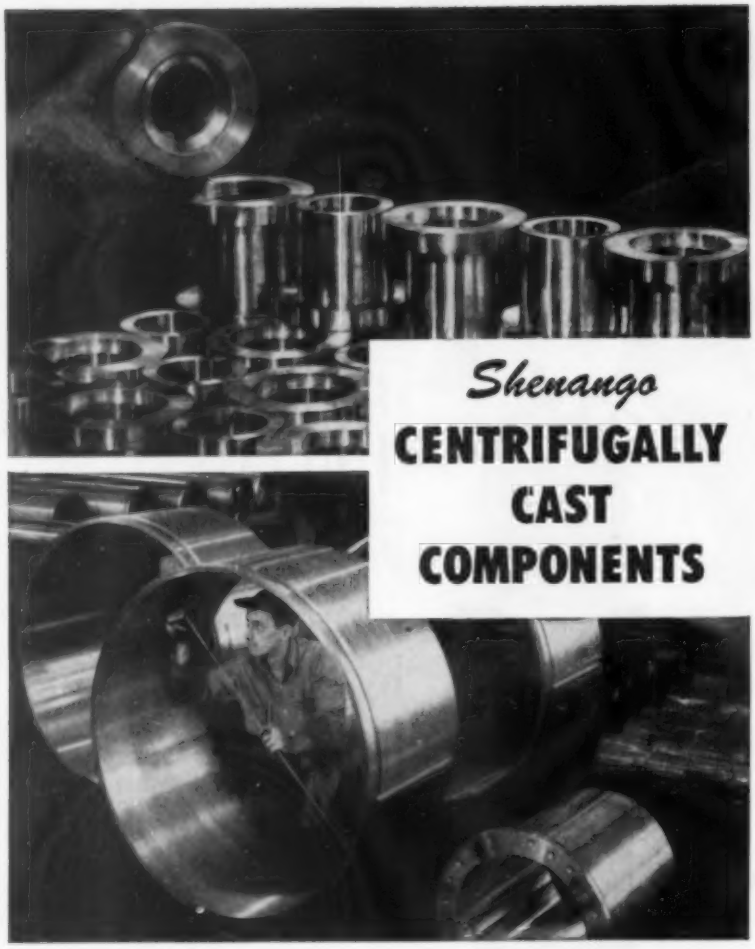


...for exceptional performance in hydraulic service

SHENANGO offers specialized production of cylinders and all other symmetrical components, small or large, ferrous or non-ferrous, rough machined or finished to your specifications. Produced by the Shenango centrifugal casting process, they assure:

- **Uniform, *pressure-dense* grain for greater strength and superior wear resistance . . .**
- **Freedom from inclusions and avoidance of porosity . . .**
- **A minimum of machining and faster finishing with excellent surface characteristics.**

Find out if Shenango specialization can spare you cost and trouble. Get acquainted also with Shenango centrifugally cast tubular *stock* available in a broad range of diameters and lengths. For helpful bulletins or engineering service write Centrifugally Cast Products Division, The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE METAL • ALLOY IRONS

LETTERS to the editor

appreciate knowing whether students can subscribe to your magazine.

MAX COVERT
Industrial Education
Wayne State University
Detroit, Mich.

You can obtain copies of the JIC Hydraulic Standards for your class, without charge, by writing to J. I. C., Box 182, North End Station, Detroit 2, Michigan. Students can subscribe to APPLIED HYDRAULICS *at the rate of* $5.00 *per year. We sent you a copy of the January* 1956 *issue which provides an index to literature in this field and should be of value to you.*

Basic Hydraulics

Sometime ago you ran a series on Basic Hydraulics for Beginners. Is this information available in booklet form, or on a reprint?

CHARLES F. GATH
Gath and Herms, Inc.
Buffalo, N. Y.

This series is no longer available. However, we are sure you will find of great value a copy of the MASTER CATALOG OF FLUID POWER PRODUCTS, *priced at* $6.50.

Hydrostatic Transmissions

I was interested in the articles appearing in APPLIED HYDRAULICS on hydrostatic transmissions for agricultural tractors. In my opinion these difficulties would be encountered:

1. To obtain a variable-capacity pump capable of delivering over 60 gpm at 3000 psi, for long periods, which would be of suitable size, weight, reliability and price for this application.

2. To obtain a pump, motor and necessary valve gear which would have a combined slip of less than 5 gpm at 3000 psi, at temperatures which would result from working at this pressure for long periods. For instance, when plowing, the maximum power available

Continued on page 16

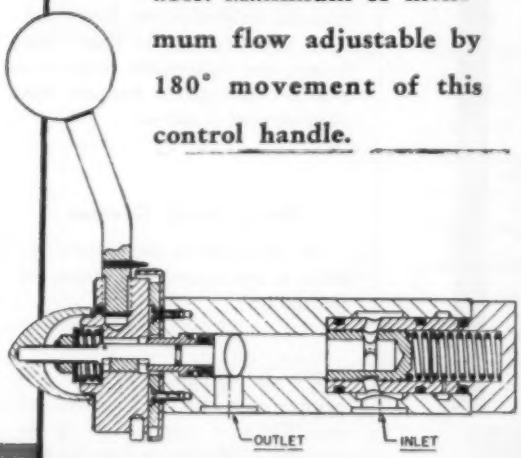
Another WATERMAN WINNER

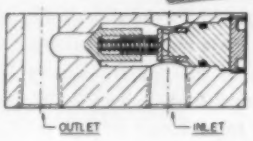
Model No. 1409

Adjustable Flow Regulator

An adjustable flow regulator adapted for manifold mounting. Sub-plate kits are furnished with built-in check valves for free reverse flow. They are interchangeable, dependable, light-weight and easily installed.

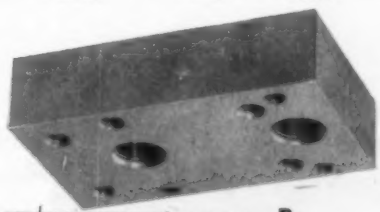
Either right or left hand rotation of control handle is available. Maximum or minimum flow adjustable by 180° movement of this control handle.





A

110534 Sub-Plate Kit with built-in check valve for free reverse flow.



B

110516 Sub-Plate Kit.

Write for illustrated bulletin A, describing the many valuable features of this Adjustable Flow Regulator.

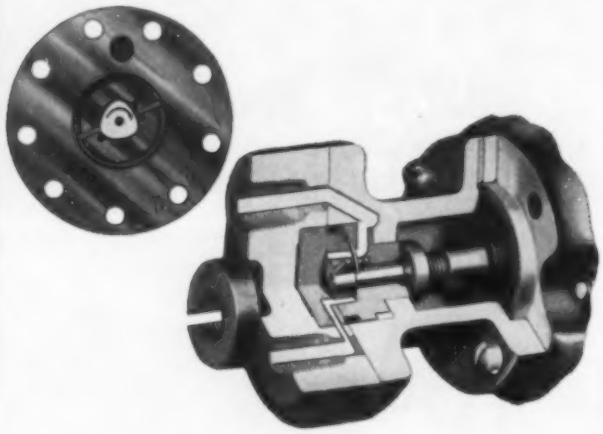
WATERMAN ENGINEERING COMPANY

725 CUSTER AVENUE • EVANSTON, ILLINOIS

WELDON

FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.

Compact • Light Weight

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

THE WELDON TOOL COMPANY

3000 WOODHILL ROAD · · · CLEVELAND 4, OHIO

LETTERS to the editor

from the prime mover is utilized at 5 mph.

If this slip is present, the temperature of the oil would spiral, with consequent lowering of the viscosity of the oil, which would increase the slip. Under these conditions, approximately 10 hp would be converted into heat. The heat dissipation of the circuit would be very low, due to the low speeds of the vehicle and small areas of cooling presented.

A speed of 15 mph is desirable for most tractors, which would demand a pump flow of approximately 110 gpm, if both wheel motors were used. This would result in very substantial pressure drop in the circuit, especially in the motor porting. For such a speed range variable capacity motors would be an advantage.

C. W. CLIFFORD,
Liverpool, England

We are glad to receive your thoughts on the type of hydraulic pump and motor needed to drive an agricultural tractor. Such equipment while presently too costly is already available. It seems to us that development work can result in a transmission at a price suitable for this field. This is a fascinating field, as indicated by the material covered in our December 1956 issue. It may be some time before the hydrostatic transmission is practical for tractors, but the potential is there.

Home Study Courses

Do any schools or universities offer a correspondence course in hydraulics?

H. C. SEXTON
Waterloo, Iowa

We do not know of any correspondence course in oil hydraulics. We have sent a copy of the January 1956 issue of APPLIED HYDRAULICS, *which gives an index to all available books and literature in this field. This should prove helpful.*

Continued on page 18

...for greater safety...LONGER

LINEAR KEEPS THE POWER IN POWER STEERING
with Roto-Mold "O" Rings

Power steering design engineers needed *lasting* seals of uniform physicals and dimensions to withstand actuating fluid pressure—mechanical wear—abuse—and chemical action. LINEAR developed precision seals for that application—to keep the power in power steering.

LINEAR'S ability to produce precision "O" rings in the most modern elastomers has helped solve a wide variety of sealing problems involving extreme ranges of temperature, pressure and destructive fluids. The exclusive Roto-Mold process assures top quality production—maximum economy—fast delivery schedules.

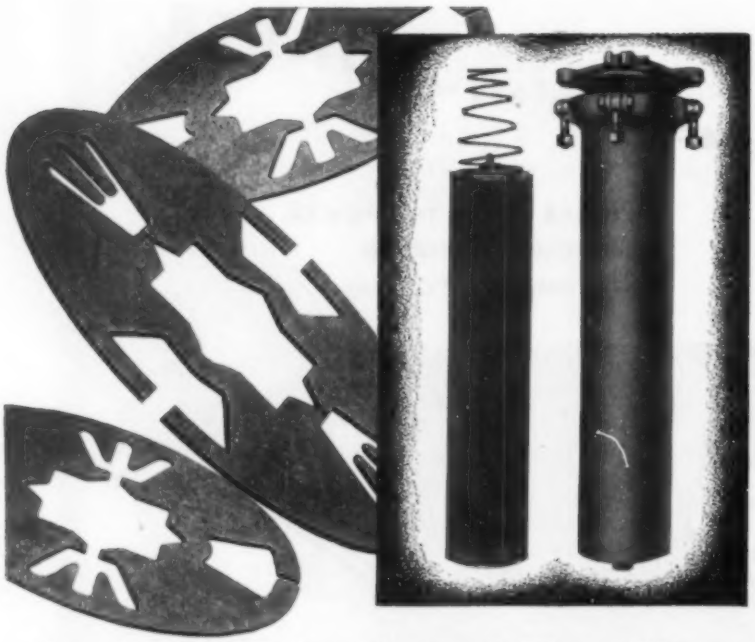
When it's a sealing problem, call on LINEAR or one of its agents for engineering assistance—and be sure to specify LINEAR Roto-Mold "O" Rings.

"PERFECTION IN RUBBER"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

Circle 69 on Reader Service Card



the NUGENT Laminated Disc Filter

This "extended area" filter utilizes an actual filtering surface area greatly in excess of its container area. The Nugent Laminated Disc Filter provides a high flow rate at low pressure drop combined with the extreme fine filtering absorption and neutralizing properties of a depth type filter.

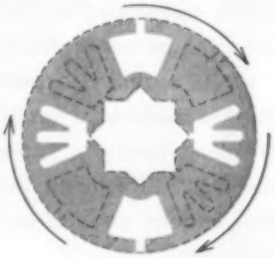
The filter charge consists of a stack of similar crenulated fiber discs, each rotated 45° from the position of the adjacent disc, thus affording proper channeling and maximum filtering capacity. Liquid passes from the exterior to the interior of the filter stack.

The filter recharge has a useful life of from 4 to 10 times that of a cellulose or waste recharge. Changing recharges requires only minutes. Cartridges are interchangeable with all other Nugent bag or depth type cartridges. Write for full details.

DESIGN FEATURES

- Provides "Extended Area" filtering
- Removes solids as small as 2 microns
- Removes acid forming contaminants
- Will not remove additives
- Contains no chemicals or bleaches
- Working pressure 125 psi—tested to 375 psi
- High pressure filters to 600 psi—tested to 3000 psi
- Built in by-pass relief
- Maximum operating temperature 375°F.

HOW IT WORKS



Each disc in filter stack is rotated 45° from position of adjacent disc for proper channeling and maximum filtering capacity.

Established 1897

Wm. W. Nugent & Co., Inc.

3426 Cleveland Street Skokie, Illinois

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

Representatives in Boston • Cincinnati • Detroit • Houston • Los Angeles • Minneapolis • New Orleans • New York • Philadelphia • Portland, Oregon • San Francisco • Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

LETTERS to the editor

Porous Metal Filters

Please send us the May 1956 issue or a copy of the article: "Porous Metal Filters", by Edward D. Kane, which appeared in this issue.

WILLIAM P. CHAISSON
Engineering Department
Package Machinery Company
East Longmeadow, Mass.

Reprint was sent.

Designer's Guide

Under the material breakdown for O-rings, on page 120 of your January Designer's Guide Issue, Minnesota Rubber & Gasket Company has a "special" listing under synthetic rubber. However, almost all the company's O-rings are of synthetic rubber and its standard stock is synthetic rubber. Was this the result of specific definitions applied?

ALLAN J. WASH, JR.
Public Relations Director
Kerker Peterson Hixon Hayes, Inc.
Minneapolis, Minn.

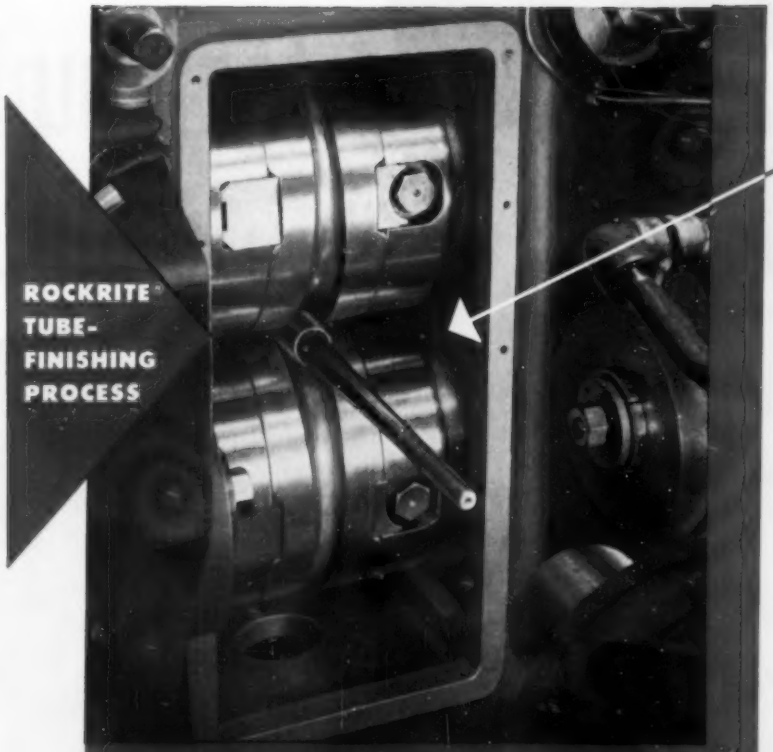
These charts were made up from information supplied on questionnaires which we mailed out. We left it up to the individual who completed the questionnaire to indicate whether a product was standard. In this case, the Minnesota Rubber & Gasket people accurately completed their questionnaire and indicated that their synthetic rubber O-rings were "standard". We made an error in using the open circle instead of the full dot.

Pressure Switches

We are interested in the data published in APPLIED HYDRAULICS on pressure switches in the April, June, August and September 1956 issues, together with the January 1957 issue. Would appreciate your sending these sheets.

B. C. RECIPUTI
Vice President
Reciputi & Weiss, Inc.
Amityville, L. I., N. Y.

Tear sheets have been sent of all available articles. ▼▼▼

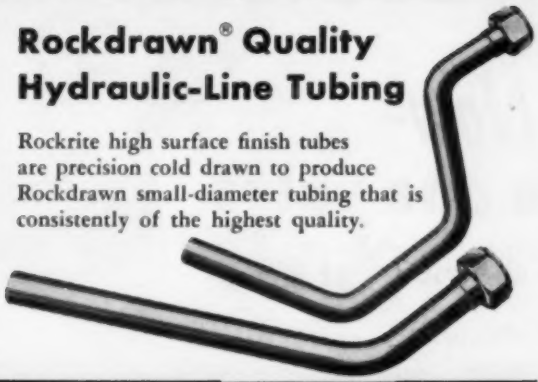


High quality begins here

This tube, leaving the Rockrite reducer, has been cold compression rolled—with great metal displacement. Result: Better structure of the metal, precision dimensions, and excellent surface finish. It is a quality tube.

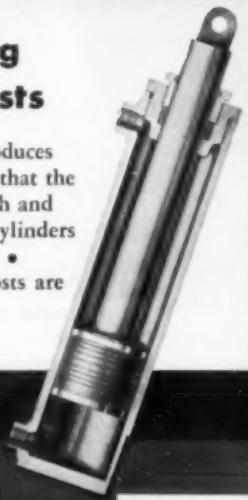
Rockdrawn® Quality Hydraulic-Line Tubing

Rockrite high surface finish tubes are precision cold drawn to produce Rockdrawn small-diameter tubing that is consistently of the highest quality.



Cylinder Tubing cuts honing costs

The Rockrite process produces such a high surface finish that the tubing can be cut to length and used as is for hydraulic cylinders with soft-packed pistons. • Machining and honing costs are always cut to a minimum.



Send for these bulletins.

TUBE REDUCING CORPORATION
WALLINGTON, NEW JERSEY
New York City Tel: CHickering 4-0877

Now – Plus Values for you ..

Now– in one valve – all these Plus Values

"Flow-Director" Pilot Head—simplifies piping and makes desired operation possible simply by piping to the proper port.

Interchangeable Pilot Heads — any pilot head fits any valve, regardless of type or size.

Replaceable Seats, Self-Cleaning—fast and inexpensive replacement of all seats. Poppets do not seat in valve body.

Solenoids — are low amperage, continuously rated industrial type.

High Speed Operation — short stroke solenoid and poppet give split second response.

Full Flow—all passages oversized for minimum pressure drop through valve.

No Springs—piston-poppets shift with air pressure.

Lightweight, Compact — aluminum used extensively . . . smaller over-all dimensions.

Corrosion Resistant — all materials corrosion resistant.

100% J.I.C. Conformance

- subplate mounted
- splash- and dust-proof solenoid covers
- solenoids inoperative with covers removed
- manual push buttons
- covers chained to valve
- *Dryseal* pipe threads

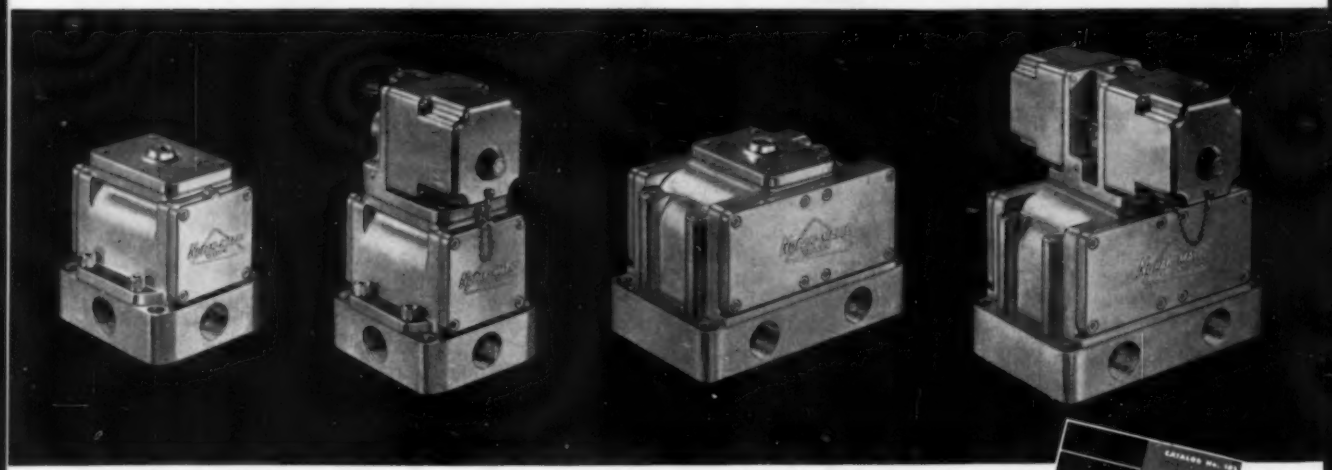
in the new *NOPAK-MATIC* poppet-type air control valves

100% J.I.C. — a complete line of poppet-type, snap-action, air control valves that comply in every detail to J. I. C. Standards . . . and *at no extra cost!*

Simplified Piping — exclusive "Flow-Director" pilot heads allow piping with fewer fittings . . . makes fewer valves adaptable to more applications.

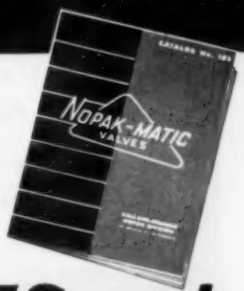
Off 'n On In Less Than 2 Minutes — millions of trouble-free operations are assured but should maintenance be necessary, a complete valve assembly can be replaced in less than 2 minutes . . . piping is never disturbed.

3 Pilot Heads Fit All Models — all pilot heads (master, single or double solenoid) are interchangeable on all valves, regardless of type or size.



NOPAK-MATIC Valves are available in ¼" through ¾" pipe sizes for 2- or 3-Way Normally Open or Normally Closed and 4-Way operation. All valves can be operated with master (air), single solenoid or double solenoid pilot heads. Solenoids are available for all standard A.C. and D.C. voltages. Four-Way valves are available with side or bottom porting.

CATALOG NO. 105 — describes and illustrates all the Nopak-matic Plus Values and gives complete dimension, installation and parts data. Write for catalog 105 now. It will be mailed promptly.

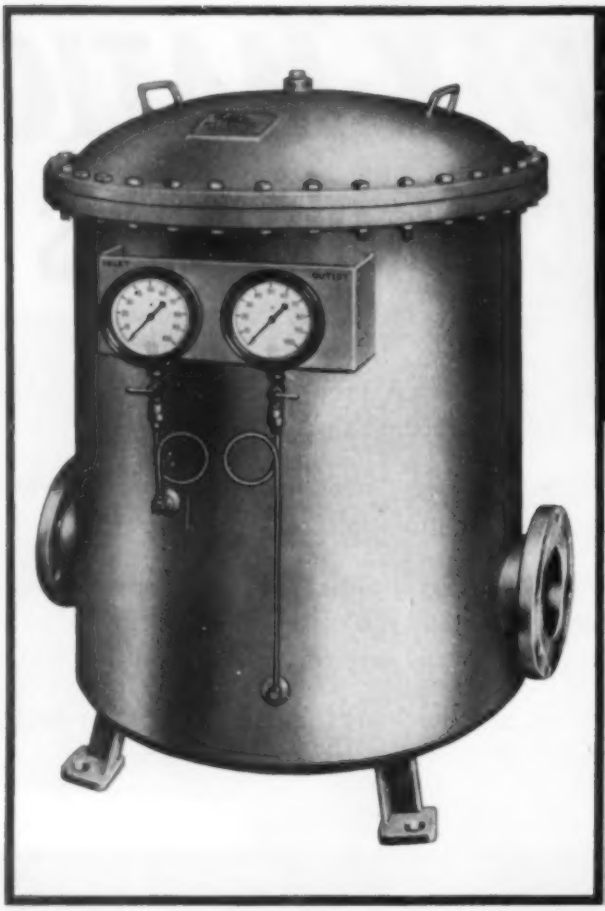


NOPAK *VALVES and CYLINDERS*

GALLAND-HENNING NOPAK DIVISION, 2743 S. 31st St., Milwaukee 46, Wisconsin

A6-600-2PB

Circle 43 on Reader Service Card



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to meet

YOUR EXACT NEEDS

for continuous micronic clarity of hydraulic fluids

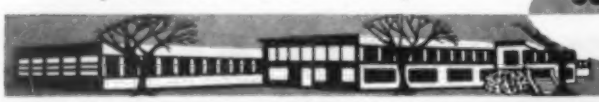
Fulflo Filters give you the exact degree of continuous micronic clarity you need for any hydraulic fluid — at high or low flow rates or pressures. You make substantial savings by extending fluid life, protecting vital equipment, reducing down time and repairs.

Fulflo Filters are especially designed for micronic clarification of fluids used where exceptionally fine tolerances are required. Standard models handle all normal flow rates and pressures. Special filters can be engineered for flow rates up to 2000 gpm or pressures as high as 5000 psi, at minimum pressure drop. Fulflo Filters employ *genuine* Honeycomb Filter Tubes in a wide range of positively controlled densities.

CFC (formerly Honan-Crane) Hydraulic Oil Purifiers avoid excessive wear of hydraulic parts and prevent clogging of valves and pistons. Filter medium is Cranite (Fuller's earth) for removal of soluble impurities as well as abrasive solids. CFC Purifiers are designed for direct connection to an individual system, as mobile units, or as part of central oil system. They quickly pay for themselves through reduced consumption of oils and protection of costly equipment.

Commercial Filters engineers are ready to help you with any problem involving micro-fine filtration of hydraulic fluids. Write for technical literature to Department AH.

Micro-Fine Filtration for Low Cost Clarity



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Plants in Melrose, Massachusetts and Lebanon, Indiana

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PURIVAC INSULATING OIL CONDITIONERS • DRI-PURE WATER-OIL SEPARATORS • PRE-COAT FILTERS • MAGNETIC SEPARATORS
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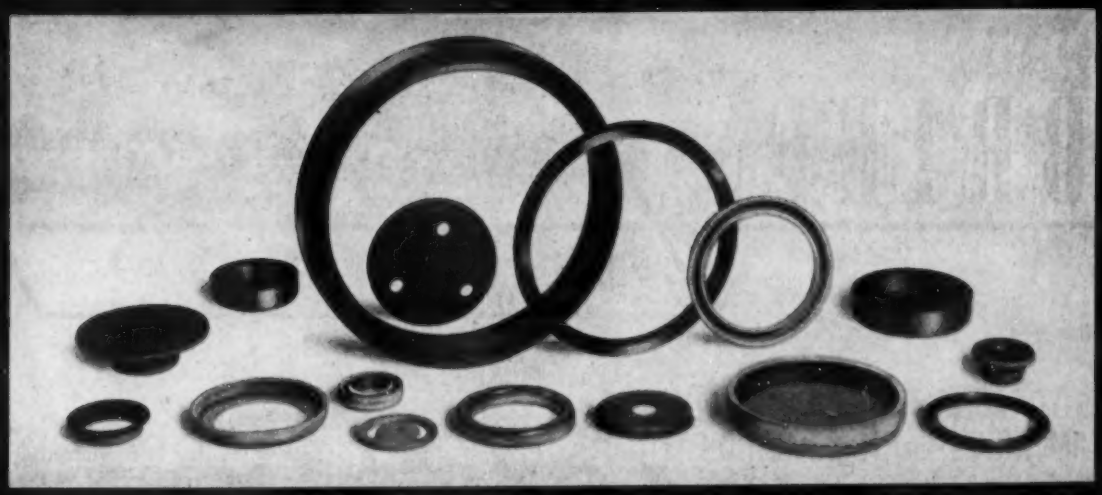

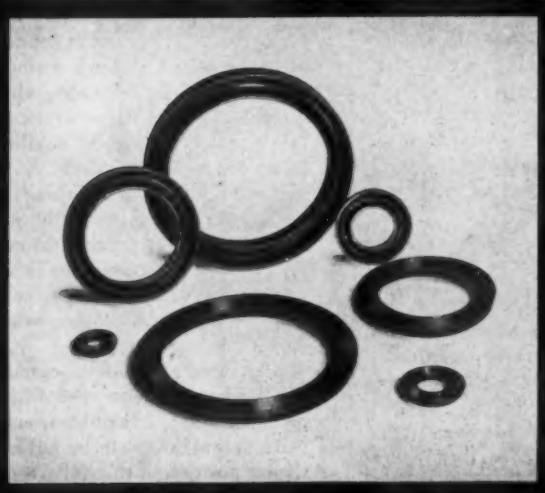

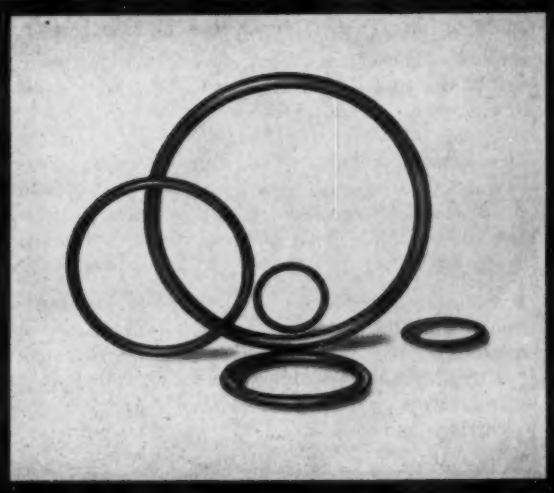

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GRATON & KNIGHT *Company* INC.

WORCESTER, MASSACHUSETTS

BRIEFS about fluid power

HYDRAULIC TRACER APPLICATION IMPROVES LATHE OPERATION

Offering a new concept of applying the tracer principle to an automatic turning machine, the unit is designed to reduce set-up time, permit quick change-over and maintain high production. This Jones & Lamson Model 40 Faymatic tracing lathe has four automatically controlled tracing cuts, with spindle drive powered by 40 hp motor.

• **Set-up:** Entire set-up for all combinations of cuts, feeds and speeds consists of four operations:

1. Setting 4 hydraulic flow control valves for desired feed of carriage and back arm.
2. Setting three sets of control drum cams to operate electric limit switches to control automatic cycle.
3. Pre-selecting electrical selector switches to pre-arrange the program or sequence and number of automatic passes of automatic cycle.
4. Placing a template onto the template holders.

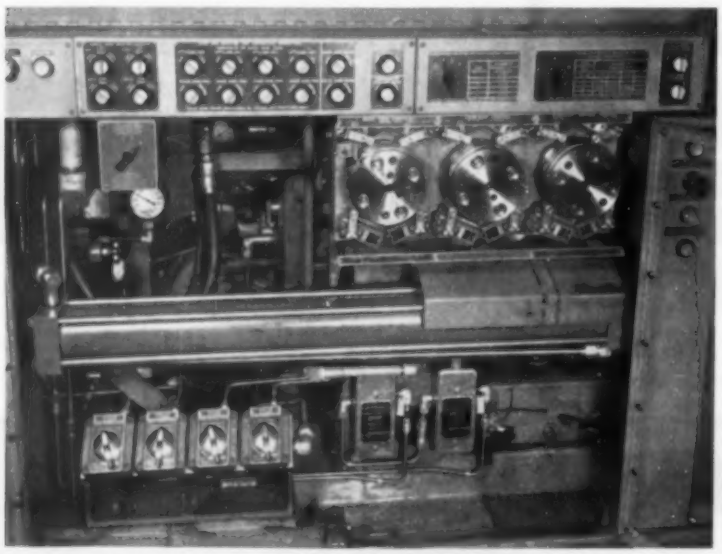
• **Operation:** Machine is hydraulically operated with solenoid valves and electrically controlled through an automatic multi-pass cycle. Hydraulic power unit consists of a fixed displacement pump, an unloading valve and an accumulator. During low volumetric demands the pump recharges the accumulator and then flows freely to the tank. Power unit is connected to the system through a single-solenoid, spring-offset valve, which isolates power unit from system in case of power failure. An auxiliary accumulator is provided in the tracer circuit. Should power failure occur, the tool is withdrawn from the work to prevent damage. This auxiliary accumulator is also used as a hydraulic pressure surge damper to permit smooth tracer operation.

Feed circuit of both the carriage and backarm is equipped with a spring-centered, double-solenoid valve and arranged to be fail-safe. Center position of this valve represents fine feed, and either extreme is coarse feed or fast motion. If local failure occurs, carriage or backarm drops automatically into fine feed. On power failure, all feeds are stopped and the machine brakes to a stop.

Carriage has two feed control valves to interchange feed rates during the cut. Feed and speed changes occur automatically during a cut, insuring optimum cutting speeds and feeds on changing diameters and angles. Also permits roughing at one speed and finishing at another.

• **Cycle:** Bar stock is loaded into the cradle. Momentary operation of a pushbutton advances the tailstock ram to imbed the work piece into the power-operated drivers. Automatic machining cycle starts with operation of a cycle-

Continued on page 26



HYDRAULIC CYLINDER in center traverses the cutting tool carriage. Control drums are shown in upper portion to the left of the hydraulic power unit. Feed controls for carriage and backarm are at lower left. Entire compartment is enclosed and can be locked to prevent tampering.

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Steering knuckle drag link boot
Universal joint cover
Bellows cover for sliding ways
C/R
Coated fabric cylinder rod boot
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Custom-designed and engineered to fit mechanical giants or midgets

Whether you want a boot two stories high . . . or no bigger than your thumb . . . let C/R Sirvis engineers solve the problem for you. They're specialists . . . backed by 78 years' experience . . . with unusual skills and ingenuity in the development and manufacture of mechanical boots. They'll design and produce a C/R Sirvis boot to your exact requirements in any size, any quantity . . . using only the finest materials: mechanical leather, selected, tanned and treated by C/R . . . nylon . . . or elastomer-coated fabric. The absolute dependability of your boot will be proved before production.

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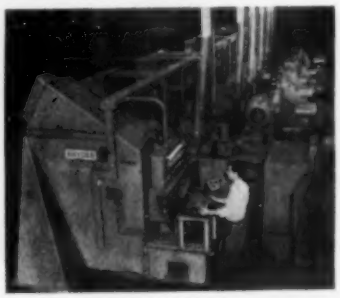
BRIEFS / continued

start pushbutton. Tracer slide advances until tracer stylus contacts the template, which brings first cutting tool into position. After first cut, relief and carriage return, the template is turned to the next position. Backarm can be operated anytime during the carriage cycle for rough facing cuts and cutting grooves or reliefs. Two-position, automatic indexing tracing tool holder on the tracing slide permits heavy roughing cuts with one tool and accurate finishing cuts with the other. On completion of the job, operation of a pushbutton returns the tailstock ram and lowers the work piece onto the cradle.

▼▼▼



This hydraulically operated, electrically controlled segmented transfer machine, designed and built by Snyder Tool & Engineering Co., mills, drills and taps a cast iron automotive engine intake manifold without turnover operations. This is achieved by turning the intake manifold up on edge and transferring it from station to station with a vertical, angular rail arrangement. The seven segment, 20 station machine uses individual bases and control panels for each segment, individual hydraulic power units. A master control panel integrates the functions of the individual control panels.

Hydraulic Control Gives Machine Versatility

Exploiting the flexibility of fluid power, Walter P. Hill, Inc. built this double end machine so that the heads have individual control, feed, and stroke adjustments. The machine can be used to form or

Continued on page 28

HYDRAULICS in AUTOMATION

No place for down-time

that's why **CROSS** specifies HYDRALUSTER tubing exclusively!

Hydraluster tubing is carrying the vital load of hydraulic transmission in this 350 ft. Cross transfer machine. Hydraluster is there because *every* part and assembly has to be 100 per cent dependable. There is too much at stake for anything less.

Why does Hydraluster get the call? . . . because it is a revolutionary improvement over any previous type of hydraulic tubing. *Inside*, Hydraluster has a new type of tubing surface, very much like a gun barrel. This smoothness cuts friction and heat, and the result is higher power efficiency and lower reaction times. This new surface is also highly resistant to oxidation and scale . . . added protection for valves, pumps and meters.

Here we quote Mr. Ralph E. Cross, Executive Vice President of The Cross Company. "*We've used Summerill Tubing for years because we felt it was the best. And when Summerill topped even their best with Hydraluster, it was only logical that we go along with the improvement.*"

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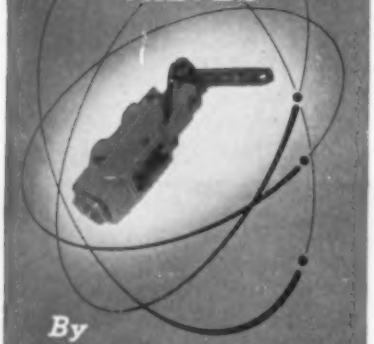
MANUAL CONTROL VALVES



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The one shown is:
MC 1888 VALVE—AIR CONTROL, THREE PORT
fulfilling the following aircraft specifications:

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EXTERNAL LEAKAGE: Zero
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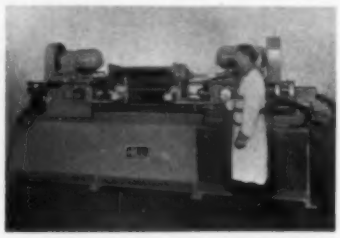
BRIEFS continued

remove metal from the ends of rod or tubular parts.

• **Hydraulic operations**—Automatic magazine feed is hydraulically operated and serves the two, hydraulic powered, motorized precision heads that can each develop up to 20 tons of thrust force. With the heads idle, parts can be fed through the magazine feed in conjunction with a length adjustment feature. Thus, the machine can operate like a forming press, expanding, reducing, flaring or beading both ends of the parts simultaneously.

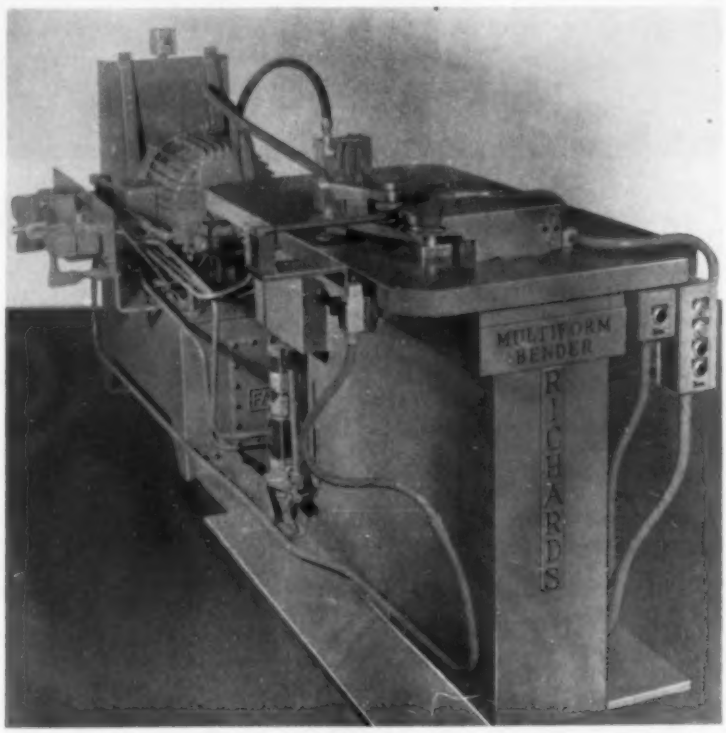
Individual control of the heads permits performing different types of operations on each end of the parts. One end of a part can be formed while the other end is being machined. With the part clamped, the head quills are automatically positioned axially to al-



low for length variations in the part. Parts are ejected onto a hydraulic cylinder operated unloader.

• **Components**—Hydraulic power units are 10 to 30 hp, providing

Continued on page 30



HYDRAULIC TUBE BENDER has an automatic production cycle of 6 seconds in shaping tubular chair back supports. Richards engineers designed this unit with standard ram stroke of 4 inches and auxiliary cylinder sweepstroke of 18 inches. Machine has 25 tons power with a 15 hp motor, and can be equipped for many production operations. Pneumatic models are also available. J. A. Richards Co., Kalamazoo, Mich., build this bender.

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The oil-resistant nitrile rubber

"...the rubber we know will resist 'em all!"

"We can't be sure just what kind of oil or other hydraulic fluid will be in contact with our hydraulic hose liners, pressure seals and accumulator bladders, so we use the rubber we know will resist 'em all!" That was the reply when one manufacturer of rubber products was asked about his choice of PARACRIL® for rubber hydraulic specialties.

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US RUBBER

Circle 125 on Reader Service Card

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Hand and Pilot-operated Types for water or hydraulic oils to 5000 psi.

• These valves give users maximum efficiency, economy and dependability. Housings are milled from steel blocks or bronze forgings. The hollow, radially ported, stainless steel plungers are hard chrome plated and polished. Renewable metal valving rings assure long life of the packers which are expanded by internal pressure . . . the higher the pressure the tighter the seal. No metal to metal seating. The valves are fully balanced in any position. Inspection — and servicing if necessary — can be done easily *in the field,* avoiding the delays of returning valves to the factory for servicing, or the need to carry large inventories of standby valves — or even parts. Complete dimensions, capacities and other data sent promptly. Write for Bulletin No. 531,— Today!

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DOUBLE SOLENOID "O-TYPE" VALVE for pressures up to 125 psi. Widely used as pilot valves and for operating air cylinders.

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Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

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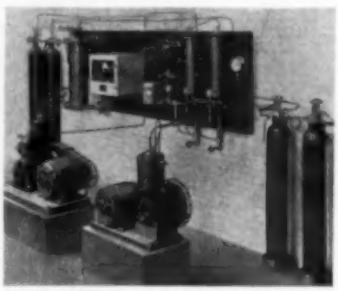
BRIEFS continued

20 to 70 gpm at 1000 psi. All hydraulic valves are manifold mounted. All hydraulic components have a 2,000 psi rating, and fittings are good for 20,000 psi. The hydraulic lines are anti-vibration mounted. ▼▼▼

Aviation Hydraulic Equipment Is Air-Tested Using 3-Stage Compressor

Specifications for testing called for a constant supply of clean, dry air at pressure of 800 to 1000 psi, and also at 3500 psi. To meet these requirements, Williams & James (Engineers) Ltd. designed a 3-stage compressor producing 6 cubic feet per minute.



• **1000 psi**—Plant consists of two separate compressor units mounted on base plates, a control panel, and two sets of air receivers.

One compressor is a two-stage, water-cooled, 5 hp machine. One of its cylinders has a 3-inch bore (first stage) and the other a $1\frac{1}{16}$-inch bore (second stage).

The other compressor unit (third stage) is a single stage, water-cooled, 2½ hp booster.

The pressure switch is connected to the two, 1000 psi air receivers. It also operates an electric solenoid which exhausts the air from the pipes between the first and second stage cylinders, and from the pipes connecting the second stage cylinder and the air receivers.

• **3500 psi**—When air at 3500 psi is required, the booster unit is

Continued on page 32

ALEMITE Announces

the all-new SURGEPRUF LINES OF REUSABLE COUPLINGS AND RUBBER HOSE

...Available Now Nationwide!

Now, for the first time, Alemite brings you a completely new line of *reusable, non-skive* couplings and hydraulic rubber hose—exclusively designed for faster, more economical replacements . . . to cut maintenance costs, downtime and inventories!

Rugged Alemite Surgepruf Couplings meet practically any original equipment or field replacement need. Hose are available for either medium-high or high-pressure service, with single or double wire braid. Couplings are made of high-strength steel . . . and J.I.C. thread design assures positive, long-lasting seal.

Contact your nearest Alemite Distributor for full details. Standardize—*save money*—on the complete new line of superior Alemite Surgepruf equipment!

Only Alemite Surgepruf Couplings Offer All These Advantages for Faster On-the-spot Replacements and Repairs!

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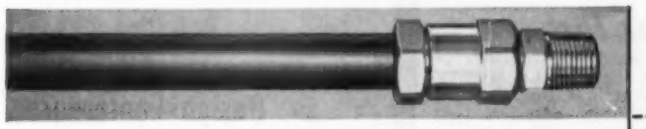
- GIVES TIGHTER GRIP! Double-wedging action gives tighter grip as insert is drawn farther into coupling.
- NO SPECIAL ASSEMBLY TOOLS REQUIRED! Fast, easy assembly with just ordinary tools!
- TYPES AND SIZES FOR ALL HYDRAULIC LINES.



New Alemite Surgepruf Couplings and Hose Have Been Factory-tested and Field-proved!

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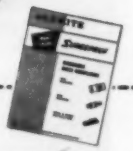
Division of STEWART-WARNER CORPORATION



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BRIEFS continued

switched on. Air is drawn from the second 1000-psi receiver to the suction side of the booster, through a pressure-reducing valve, to keep pressure at less than 600 psi. After compression in the booster, the air is fed to two other air receivers.

• **Moisture removal**—Moisture traps in the two water coolers drain away moisture condensed from the air as it is cooled. One cooler operates after the first stage and the other after the second stage of compression.

An electric dryer on the air route between the two 1000 psi receivers removes any remaining moisture by adsorption. ▼▼▼

Better Hydraulic Systems And Components . . .

. . . will be the subject of the second Fabricating Machinery Hydraulic Conference, sponsored by Vickers Incorporated. Sessions will be held May 21 and 22 at the Sheraton Cadillac Hotel in Detroit. This will be an opportunity for major fabricating machinery users and builders to exchange information.

Keynote speaker will be W. L. Cruse, executive vice president of the Society of the Plastics Industry. Moderators will be J. R. Hemeon, Hydraulic Equipment Engineer, Ternstedt Division, General Motors Corporation, Trenton plant; and O. J. Maha, vice president, Hannifin Corporation. ▼▼▼

A.S.M.E. Design Conference

Methods for development of new designs by American industry will be the theme of the second annual Design Conference, sponsored by the machine design division of the American Society of Mechanical Engineers. The Con-

Continued on page 36

KOPPERS SEALING RINGS REDESIGNED to give the most efficient sealing available!

Reduce Leakage to a Minimum!

Fewer Rings Required!

Redesigned Koppers Sealing Rings provide *tighter,* better sealing for your hydraulic, pneumatic and other applications . . . under a variety of operating conditions. And, you need *fewer* rings because Koppers Sealing Rings are redesigned to give the *tightest* seal.

Koppers *redesigned* Sealing Rings can be used for static sealing, for sealing rotating and reciprocating motion . . . under high temperatures, corrosive conditions, poor lubrication and where high-strength materials are required. Koppers Sealing Rings are available in grey iron, in high-strength ferrous and non-ferrous alloys.

A wide range of standard Koppers Sealing Rings is immediately available. However, if you have a new application, our engineers will *custom-design* a ring to fit your individual needs. They'll produce a ring that gives you top performance under your particular operating conditions. For more detailed information, write to: KOPPERS COMPANY, INC., Piston Ring and Seal Dept., 1504 Scott Street, Baltimore 3, Maryland.

KOPPERS

SEALING RINGS

Koppers Company, Inc.,
Metal Products Division
Piston Ring And Seal Dept.

Engineered* Products Sold With *Service

Circle 65 on Reader Service Card

The "O" Rings you want are RIGHT HERE

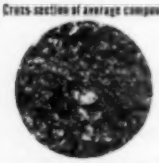
This ultra-modern plant supplies—in volume—"O" rings with outstanding performance advantages. VIX-SYN rings are supplied in standard compounds covering a wide range of needs. If your problem requires a special compound because of heat, pressure or fluid conditions, we will work with you either to select one already available or to develop the type needed.

STOCK APLENTY

There's no such thing as a production emergency if Houghton is your "O" ring source. Adequate stocks of standard sizes are maintained. Should your production line be caught short, a phone call will speed the "O" rings you need on their way to you.

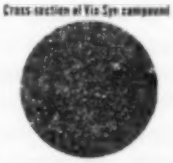
Houghton's super-dense VIX-SYN rubber formula is the key to long "O" ring life

Cross-section of average compound



Coarser, less dense pattern of rubber is indicated in this photomicrograph of a standard packing compound, magnified 240 diameters. Note lack of uniformity.

Cross-section of Vix Syn compound



Fine-grain density of rubber throughout Houghton Vix-Syn packing is shown in this cross-section similarly magnified. This compact, homogeneous quality means longer packing life.

Houghton Vix-Syn plant

Houghton VIX-SYN Synthetic Rubber is also available in "V's", "U"-cups and special shapes and in a variety of compounds and durometer readings. Vim leather back-up washers specifically designed for use with "O" rings, and fabricated rubber packings, are also supplied. Ask your Houghton Man for latest bulletin, or write to E. F. Houghton & Co., 303 W. Lehigh Ave., Phila. 33, Pa.

More Capacity
On The Way
Because more companies are choosing Houghton "O" rings every day, added plant capacity is on the way. It has to be, because Houghton will not compromise the present prompt service or decrease stock volume. New or old, every customer gets the same personalized service.

products of . . . E. F. HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

BRIEFS continued

ference will be held in conjunction with the Design Engineering Show at the New York Coliseum, May 20 to 23. Exhibits will include hydraulic and pneumatic components. ▼▼▼

High Horsepower Hydraulics . . .

. . . will be discussed by Richard J. Mitchell at the April 30 meeting of the Fluid Power Division, ASME Philadelphia Section.

Richard J. Mitchell

Mitchell is application engineer of the Waterbury Tool Co., and is well known for marine and industrial applications in the fluid power field. ▼▼▼

$7,000 Scholarship Contest

Ten International Education Awards, for engineering students interested in tool and production engineering as a profession, are again being offered by the American Society of Tool Engineers. Awards of $700 each will be made to outstanding engineering students in the United States and Canada.

Application forms have been sent to 159 accredited engineering schools. ▼▼▼

BRIEF NOTES

MOLY-FILLED RUBBER . . . Dynamic rubber parts such as O-rings, packings, ball seats and friction seals have all shown improved performance when made from Moly-filled rubber. Surface friction is lowered, stability improved, and wear resistance, resistance to cold flow and thermal conductivity are all increased.

COOPERATIVE RESEARCH . . . carried on by trade associations, professional and technical societies and other cooperative groups, amounts to $21 million, and the character of work done is even more significant. Since these organizations know the research needs of their respective fields, investigations they sponsor are of special importance.

MAGNETIC DEVICE PREVENTS SCALE . . . Water or fluids are passed through concentrated magnetic fields which produce physical changes in the incrusting salts, so they cannot adhere as scale to piping. Unit handles from 2 to 17,600 gpm.

HYDRAULIC TEST STANDS . . . Greer Hydraulics, Inc., was awarded an Air Force contract for $1,300,000 worth of propeller governor tests stands to test the performance and operating characteristics of electric and hydraulic propeller governors by simulating conditions encountered in actual flight.

BUSINESS BRIEFS

COMPANY GROWTH REPORT . . . Aeroquip's president, Peter F. Hurst, anticipates a 15% increase in sales for their fiscal year 1957. This would take sales from the $33.3 million level in 1956 to $38 million. First quarter returns look even better than this prediction. Sales were up 25%.

FLICK-REEDY SECURITIES . . . are being offered in units of $100 of 6 per cent subordinated debentures, and 10 shares of $1 par of stock. Price for the package is $115. The offering is being made directly by the company, and first chance to buy is being offered to employees, customers and friends of the firm. Total offering is $1,200,000 debentures due Feb 1, 1972 and 120,000 shares of stock.

Fluid Power For Plant Maintenance

Plant maintenance people, like others, are interested in speeding and at the same time lightening their tasks by the use of fluid power. Despite the skeptics who

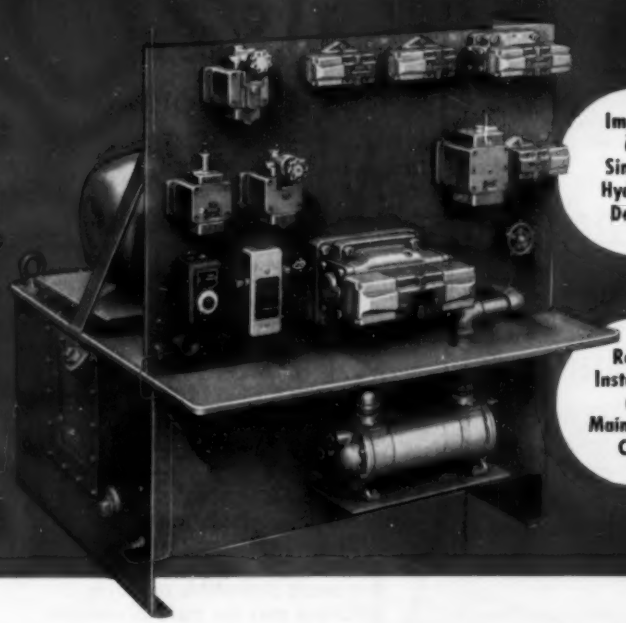
Portable hydraulic bender for pipe, tubing, and conduit from ½ to 4 in. diameter uses a hydraulic cylinder and a hand or electrically driven pump. Pipe is supported at both ends while a bending shoe is advanced against the center of the bend by the hydraulic cylinder. The bender is a product of the Greenlee Tool Co.

said that the myriad tasks performed under the heading of plant maintenance did not lend themselves to fluid power application, a tour of the 8th National Plant Maintenance and Engineering Show held at Cleveland's Public Auditorium the last four days in January turned up some interest-

Continued on page 38

It Takes MORE than a Collection of Parts

To Make A VICKERS CUSTOM BUILT POWER UNIT



Improve and Simplify Hydraulic Design

Reduce Installation and Maintenance Costs

A Vickers Custom Built Power Unit is much more than a collection of parts . . . just as the machines you build are more than the castings, shafting, gears, motors, etc. that go into them.

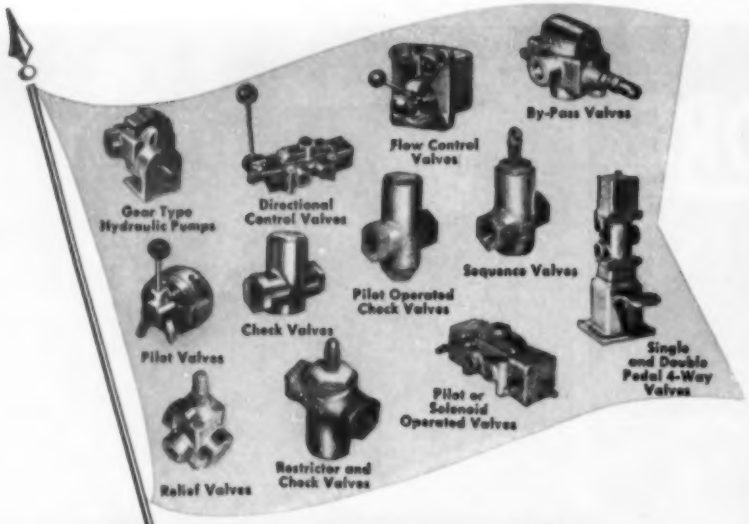
The Vickers Unit is designed and built with the "know-how" obtained during more than a quarter century of experience in practically every kind of hydraulic operation, plus a thorough understanding of your needs. It is built exactly to your individual requirements. All necessary pumps, valves, intermediate piping, oil reservoir, motors, controls, etc., are in one compact and self-contained "package". It includes all needed hydraulic accessories such as oil filiers, air cleaners, oil level gauges, fittings, etc. Hydraulic connections may be grouped in a conveniently located manifold.

The result is simplification of hydraulic design and important savings in installation and maintenance costs. Vickers undivided responsibility for the entire hydraulic control system is another important advantage to both the machine builder and his customer. • Write for new Bulletin 52-45.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1474 • Detroit 32, Michigan

Application Engineering Offices: ATLANTA • CHICAGO CINCINNATI • CLEVELAND • DETROIT • GRAND RAPIDS HOUSTON • LOS ANGELES AREA (El Segundo) • MINNEAPOLIS • NEW YORK AREA (Summit, N. J.) • PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) PORTLAND, ORE. • ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE • ST LOUIS TULSA • WASHINGTON • WORCESTER
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto 6053

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



BY ANY STANDARD...

ADEL *Refinements* assure Plus Performance for Your Equipment

Designers and Engineers have set these standards for Industrial Hydraulic Equipment

Rugged simplicity • Long life • Simplification of piping • Reduced installation costs • Greater accessibility for maintenance • Completeness of line • Over-all economy

ADEL brings them all to you!

Smooth economical hydraulic power for Pushing, Pulling, Lifting, Pressing, Clamping and Controlling.

Illustrated are but a few of a wide variety of ADEL industrial hydraulic control equipment that offer definite benefits to both the user and builder of machine tools and many other kinds of equipment. ADEL products incorporate proven design and precision construction features that assure dependable operating efficiency over the years. A complete line for every application. You can simplify your Hydraulic Power Motion Problems by specifying ADEL.

For complete engineering specifications and counsel, Address:
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ADEL PRECISION PRODUCTS
A DIVISION OF GENERAL METALS CORPORATION

BURBANK, CALIFORNIA · HUNTINGTON, WEST VIRGINIA

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Air-Draulic Equipment Company
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UTAH •
Robert Taylor & Sons
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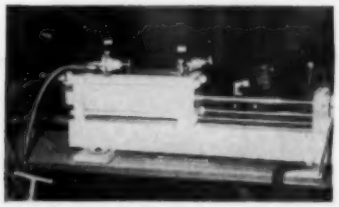
WASHINGTON •
Haskel Engineering & Supply Co.
Seattle, Washington

BRIEFS continued



Hose clamp installer made by Screw Machine Products Co. is a pneumatic cylinder for bench mounting. It grips the ends of a wire hose clamp and then by linear movement of the cylinder, tightens the clamp. An integral pressure regulator can be set to control the tightening force exerted and thus correctly tighten various sizes of clamp.

Hose clamp installation and removal are speeded by bench-mounted air cylinders. The installer, left, and remover, right, are made by Band-It Co. For installation, a clamping device grips the end of a steel-strip clamp and the cylinder then pulls the clamp up tight. Degree of tightening is controlled by an integral pressure regulating valve. The clamp remover, or cutter, is a knife actuated by the air cylinder through a linkage.

ing applications. Among them was a powered floor sweeper using a hydrostatic transmission on which we hope to report in detail later.

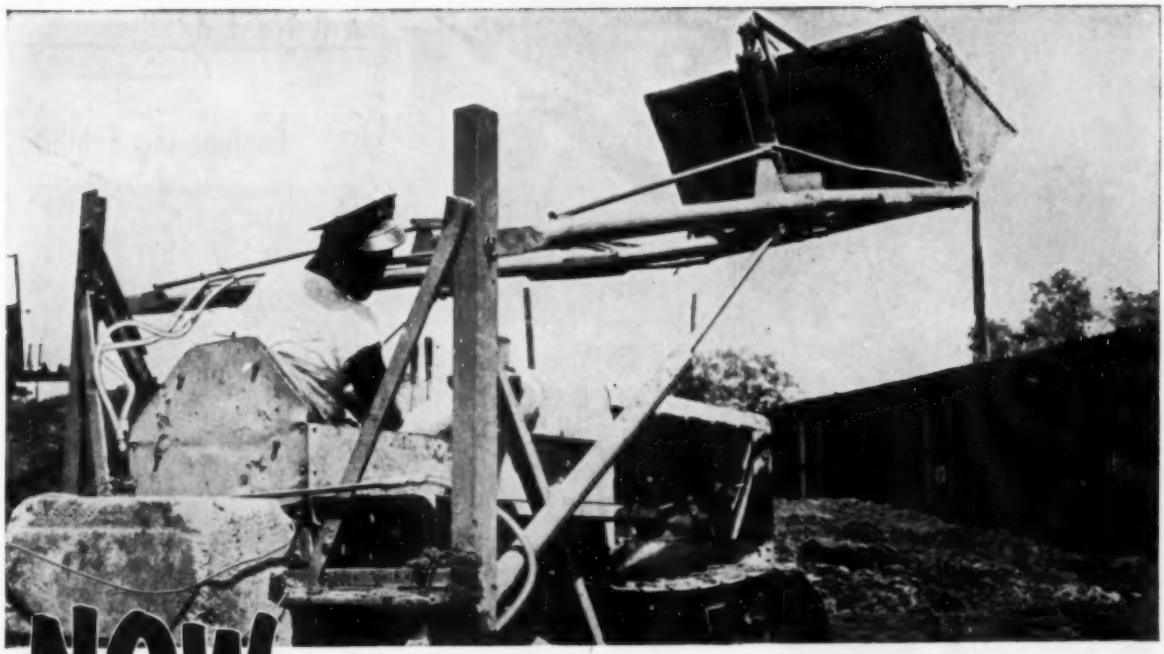
▼▼▼

Turbojet Engine Hydraulics Symposium

Vickers Incorporated will hold its second annual Jet Engine Hydraulics Symposium at Hotel Statler, Detroit, April 22 through 24. Included in the agenda is a tour of Vickers administrative and engineering center, featuring a demonstration of Vickers dynamic fuel control test stand. Theme of the Symposium will be the use of hydraulics on turbojet engines.

▼▼▼

Continued on page 40



NOW •• the right hydraulic hose assembly for every need

For the first time a world-known *hose manufacturer* offers a correct hydraulic hose assembly for every industrial need . . . bulldozers, concrete mixers, dump trucks, farm machinery, grease racks, power shovels.

This means you can get quickly, correct lengths of highest quality Gates Hydraulic Hose ready-fitted with exactly the permanent or re-usable couplings you want.

Over-all quality control and a nation-wide service organization put Gates in a *unique* position to assist manufacturers of machines, vehicles and implements with hydraulic system applications.

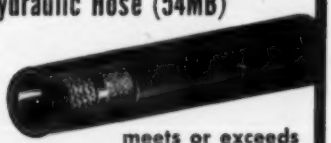
GATES Distributors are in the **Yellow Pages**

Consult the yellow pages of your phone book for your nearest Gates Engineering Office.

The Gates Rubber Co., Denver, Colorado

The Mark of Gates *Specialized* Research

Gates High Pressure Hydraulic Hose (54MB)



meets or exceeds SAE specifications

This smooth-covered, easy-to-keep-clean hose has reinforcing braid of extremely flexible high-tensile wire, made expressly for this use. Black, oil-resistant rubber withstands heat, abrasion and weather exposure. Recommended for systems subjected to shock loads and heavy pulsating pressures.

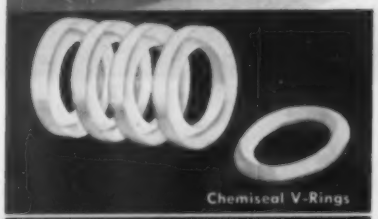
Gates Medium Pressure Hydraulic Hose (19HB)

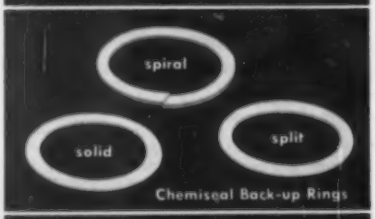
Same quality construction, but with braided cord reinforcement — ample for the lower pressure applications.

Gates Hydraulic Hoses

TPA 192

preferred by leading hydraulics engineers





TEFLON* packings are preferred by leading hydraulics engineers because they provide maximum security at vital points.

Chemiseal† packings, made of TEFLON, are chemically impervious, require no chemical inspection, have zero swelling in all hydro-carbons, new synthetic hydraulic fluids and solvents.

They offer unsurpassed anti-friction properties, are tough, resilient, non-flammable, long wearing. They have a service temperature range from minus 110° F to plus 500° F.

Have you tested the complete line of Chemiseal packings for aircraft hydraulics? Write for further information and samples.

United States Gasket Company
Camden 1, New Jersey

†U.S.G. trademark
*du Pont trademark for its tetrafluoroethylene resin.

United States Gasket *Plastics Division*
OF THE GARLOCK PACKING COMPANY

BRIEFS continued

Engineering Exhibit

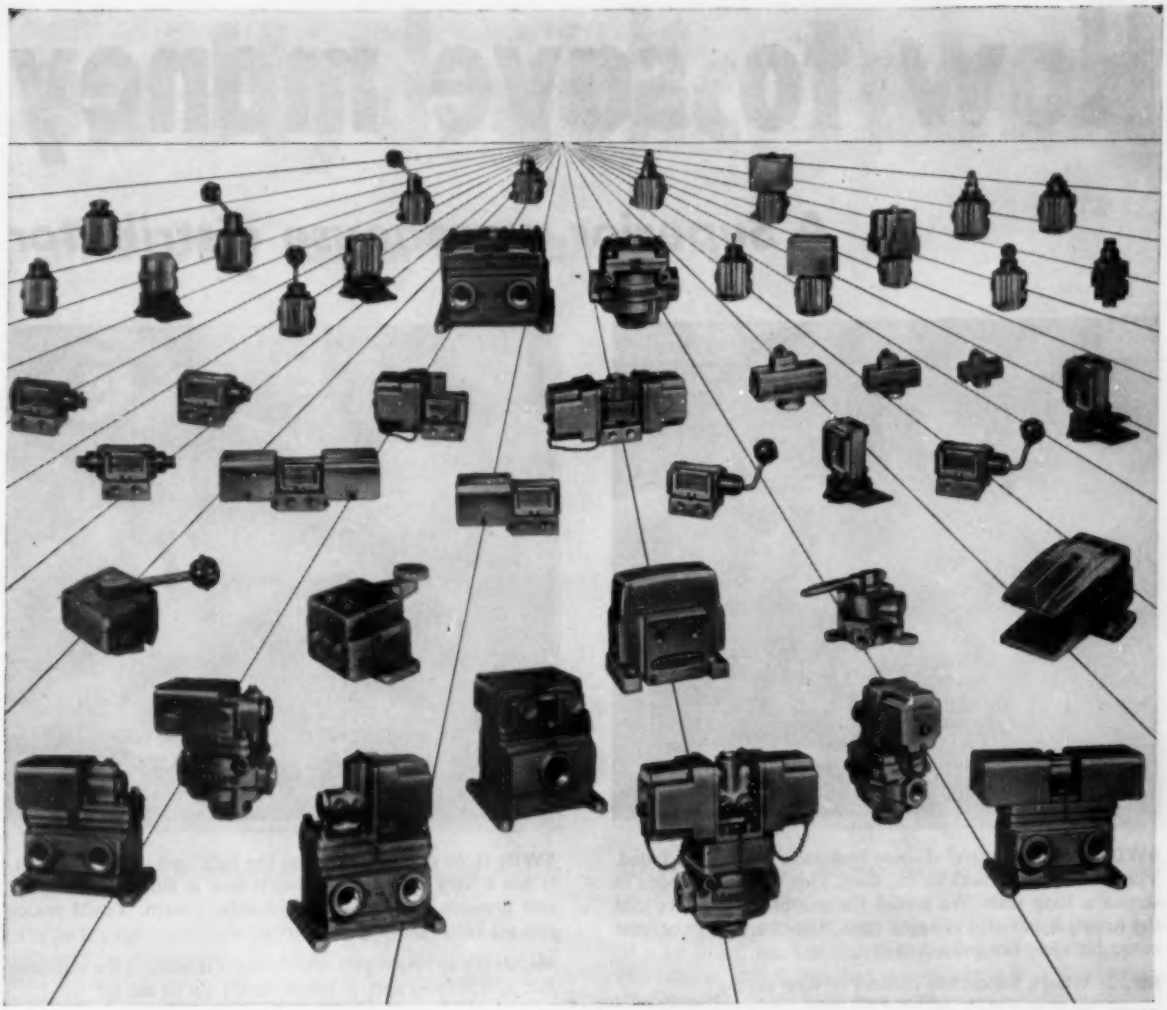
J. R. Hemeon illustrated his discussion of hydraulic systems with a series of color slides.

Exhibit of Pneu-Hydraulics, Inc. was staffed by Lee Parsons, Al Holden, and Jim Carver.

Arthur Van Wormer, Vickers district manager, explains the merits of one of their pumps to J. H. Smith of National Acme Company.

Fluid power got a lot of attention at a recent meeting of the Cleveland Engineering Society. Featured speaker was J. R. Hemeon, hydraulic equipment engineer, Ternstedt Div., General Motors Corp., Trenton Plant. His

Continued on page 44



These valves like tough jobs

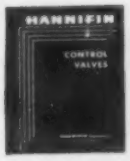
Discriminating engineers are finding that out. More and more of them are specifying Hannifin valves for every kind of directional air control—including the really tough jobs.

There are plenty of reasons why: Inspired simplicity of design. Fewer parts—and *those* easily and quickly replaceable. Ability to serve a wide range of applications with fewer valve models. And—above all—fast, smooth operation.

Your Hannifin man will gladly give you the whole story. We'll tell you where to get in touch with him—after you examine the big Hannifin catalog.

AIR CONTROL

HANNIFIN

VALVES

For this complete catalog **showing all the Hannifin directional air control valves, write to Hannifin Corporation, 545 South Wolf Road, Des Plaines, Illinois.**

Circle 50 on Reader Service Card

How to save money

A Superior warehouse distributor

SWD: Here's a sample of some hydraulic tubing that failed. You can see the cracks in the flare. This tubing has been in service a long time. We traced the trouble to the fact that the tubing is not of non-aging steel. Also the carbon content is too high to offer good ductility.

Mr. J: What's the carbon content of your tubing?

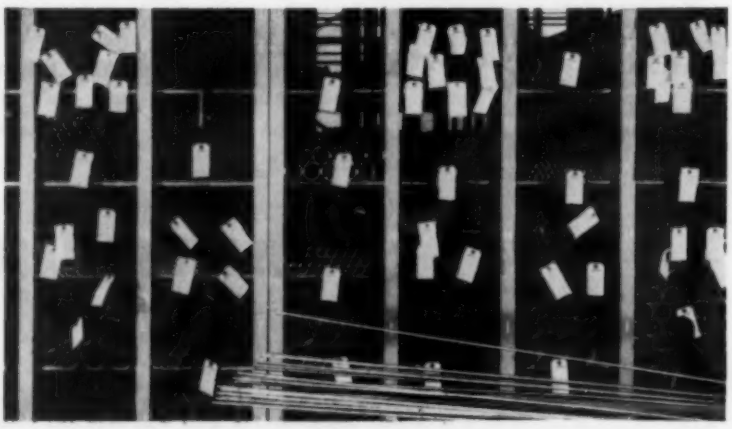
SWD: They hold it to .12% maximum carbon. And since they anneal all tubing in controlled atmosphere furnaces, there's no carbon pickup. That gives you a non-aging tubing with good ductility. The trick is to keep it bright on both OD and ID.

SWD: Hold that sample up to the light and look through it. It has a very smooth ID. You'll find it reduces turbulence and pressure drop in your hydraulic system. You'll notice you get better performance, too.

Mr. J: It's so bright you could almost mistake it for stainless. But how do you keep it bright until I get to use it?

SWD: Superior coats it with a rust preventive. They dip it just before shipment. It just can't rust while it's on the racks, and it stays bright indefinitely. Many of my customers keep the tubing in the original boxes until they're ready to use it, and that's proof of what I say.

Superior Tube Company products are sold nationally through leading warehouses. Consult your local telephone directory.



on Hydraulic Tubing

talks with customer Jones

Mr. J: Does it fabricate easily? Can I use standard bending tools?

SWD: It's very easy to work. In fact, Superior specifications call for flare testing every length of tubing. Mr. Jones, you'll find you can fabricate this tubing for *any* hydraulic application!

Mr. J: How does it stand up under various pressures?

SWD: All hydraulic tubing from Superior is 100% tested under hydrostatic pressure. I'll give you one of our bulletins that lists our wide variety of standard OD's and walls to cover almost any working or bursting pressure limit.

Mr. J : But I thought you were going to save me some money on hydraulic tubing?

SWD: I just did, Mr. Jones. Suppose after you've sold one of your machines, the hydraulic lines fail? Your customer has repairs, downtime, lost man-hours. He is dissatisfied, your reputation has been hurt, and he'll probably want you to make good anyway. But you can be *sure* of dependable, leakproof lines with Superior Hydraulic tubing of SAE quality. We sell a lot of it, and our customers tell us it's the best they've ever used.

Mr. J: That makes sense. Good-bye, and thanks for your help.

Your local Superior distributor can help you with *any* tubing problems. His long and varied experience with tubing qualifies him as a real expert. Often he can offer you money-saving recommendations. Chances are he can fill your order immediately from his stocks of Superior hydraulic and other tubing. From his daily contact with the mill, he also knows best how to expedite information and orders for you. He can save you important time and money. Call on him today.

For more information on Superior (SAE) Hydraulic tubing, get a free copy of Bulletin 39 from your local distributor—or write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010 in. to ⅜ in. OD—
certain analyses in light walls up to 2½ in. OD

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If you are interested in a good starting salary and a successful engineering career, send a summary of your educational and practical background to:

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204 Bendix Drive, South Bend, Ind.

The broader the base the brighter the future

It just makes good sense—the range of job opportunities is far wider and advancement opportunities greater with a company operating on the sound basis of diversified engineering and manufacturing.

BRIEFS continued

topic was: "Advantages of a Good System."

Local representatives for more than 40 companies, making air and hydraulic components, exhibited their lines and answered the questions of the 200 engineers from Cleveland industry. ▼▼▼

Air Powered Testing Machine

Inspection of rubber seals was a slow, inaccurate process; difficult for the operators and hard on their fingers. Using pneumatics, the Allis Seal Company built this machine to do the job. It has already given them three years of efficient, trouble-free operation, and has more than paid for itself.

• **Pneumatics**—Only two air cylinders are required. One actuates the clamping jaws which prevent the part from spreading under internal air pressure; the other holds the seal on the seat

against the clamping jaws while the part is being tested by air pressure. A timer and a 3-way valve handle the air for pressure-testing. Automatic operation is controlled by limit switches.

• **Advantages**—Use of pneumatics permitted simple design and inexpensive components. Produc-

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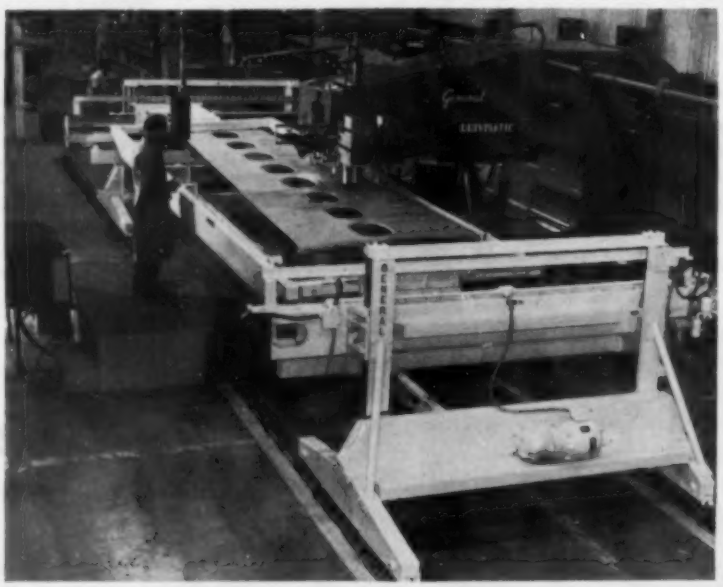


Fluid power is combined with electronics to drive fuel-sealed slug rivets automatically and with pin-point accuracy. Longitudinal travel is governed by the hydraulic system, and transverse travel is controlled by the pneumatic system. Northrop Aircraft, Inc. has increased production 400 percent with this machine.

Circle 62 ⟶

a rare combination

QUALITY

The recognised Keelavite standards of high quality maintained throughout.

INGENUITY,

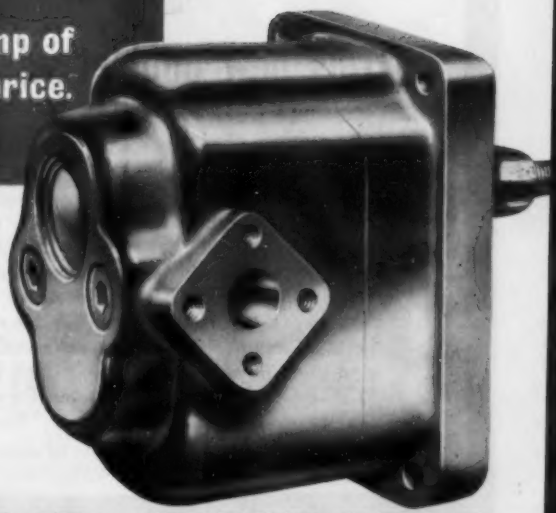
Patented features include precision hydraulic location, eliminating wear plates

SIMPLICITY

Four components only achieve the ultimate in simplified construction.

ECONOMY

The end result is a quality pump of high efficiency at a very low price.



The new range of

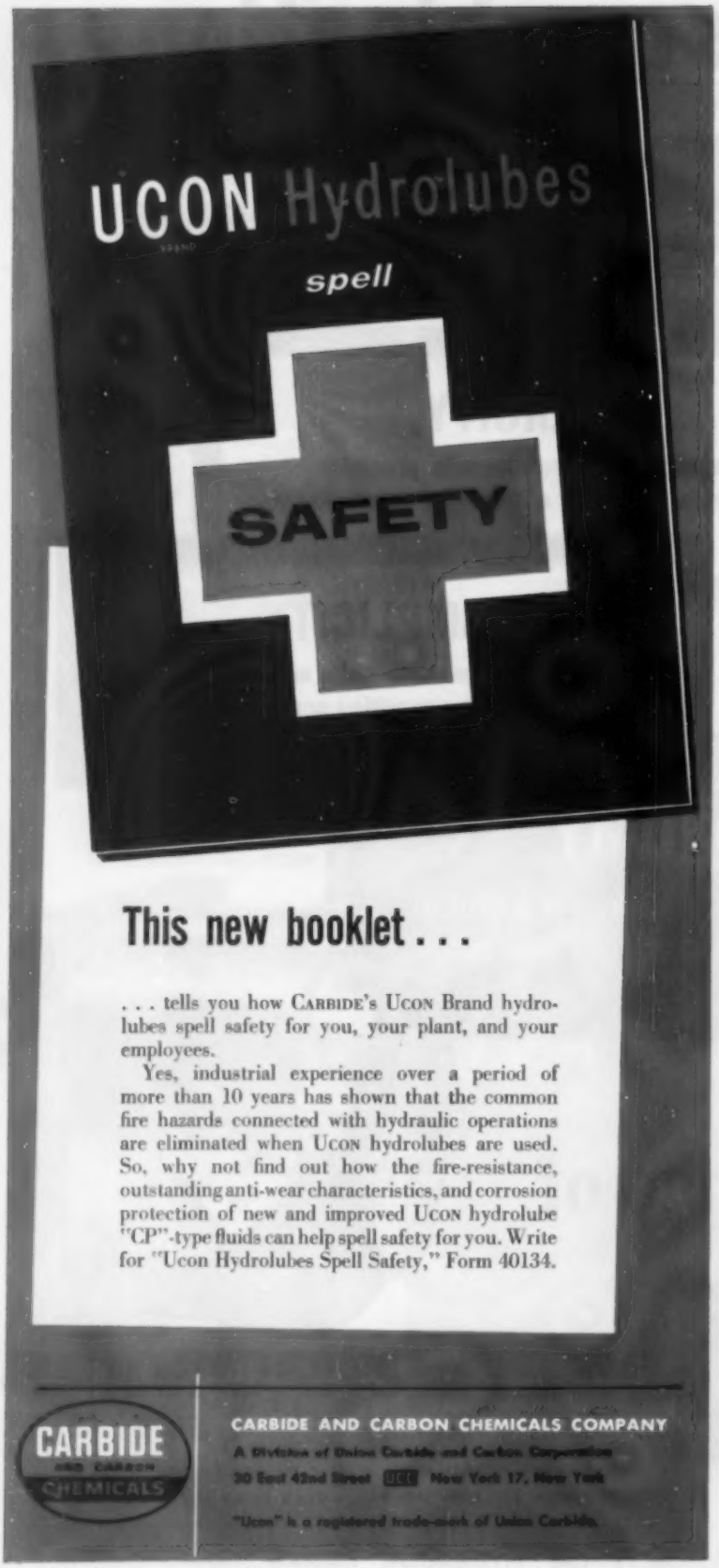
Keelavite GEAR PUMPS

G.P. SERIES

THE RANGE COVERS SIZES FROM 4 TO 28 G.P.M./1000 R.P.M.
MAXIMUM PRESSURE 2000 P.S.I. — PEAK SPEED 3000 R.P.M.

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

KEELAVITE ROTARY PUMPS & MOTORS LTD., ALLESLEY, COVENTRY *Telephone: Meriden 441.*
Canadian Agent: JOHN SPOTTON CO., LTD., 21 CARSON ST., TORONTO 14, ONTARIO



This new booklet . . .

. . . tells you how CARBIDE's UCON Brand hydrolubes spell safety for you, your plant, and your employees.

Yes, industrial experience over a period of more than 10 years has shown that the common fire hazards connected with hydraulic operations are eliminated when UCON hydrolubes are used. So, why not find out how the fire-resistance, outstanding anti-wear characteristics, and corrosion protection of new and improved UCON hydrolube "CP"-type fluids can help spell safety for you. Write for "Ucon Hydrolubes Spell Safety," Form 40134.

CARBIDE AND CARBON CHEMICALS

CARBIDE AND CARBON CHEMICALS COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, New York

"Ucon" is a registered trade-mark of Union Carbide.

BRIEFS continued

tion was increased almost 500 percent and inspection is now 100 percent accurate. Operator fatigue has been eliminated. ▼▼▼

Air-Oil Package Speeds Assembly

Dual exhaust tail pipe supports are assembled rapidly using a combination of hydraulics and pneumatics. Denison Engineering Company adapted an air cylinder to their pressure sensitive hydraulic multi-press to force the shoulder shaft into the bushing assembly.

• **Air**—An air cylinder, actuated by the press controls, forces in the shoulder shaft. When the shaft is

properly inserted in the bushing, the air cylinder reverses, permitting a new shaft to discharge into assembly position from the magazine.

• **Oil**—Bushing and shaft assembly is positioned in the 6-ton hydraulic press fixture, and the press and shaft assembly fixtures are then energized by two palm buttons. The press stakes each end of the shaft, securing the offset arms to the shaft, while the shaft assembly fixture is simultaneously inserting a shaft in the bushing assembly. ▼▼▼

Now Available!
Second Printing
"A Beginner's Course in Basic Pneumatics"
$1.50 per copy
APPLIED HYDRAULICS
812 Huron, Cleveland 15, Ohio

New ASCO SAFETY SHUT-OFF VALVE provides tight seating... large flow capacity

FM

Factory Mutual Approved

Important design features of this new ASCO valve — absolutely tight seating on gas — and large flow capacity — ideally suit it for use as a safety shut-off valve on gas and oil fired furnaces, ovens and boilers.

This new ASCO Solenoid Valve, Bulletin 8022, assures safe operation because its globe type seating, with integral crown type seat and soft composition disc, tightly seals off gas or oil. A unique combination — Y type body and oversize port (in 1¼"-3" sizes) provides flow almost equal to that of a "straight through" gate valve. Factory Mutual Laboratories has approved the Bulletin 8022 in 1¼"-3" sizes for handling manufactured, natural, and L-P gases in maximum ambient temperatures of 104° F. Valves can also be used for fuel oil and non-corrosive liquids and gases.

This free handle valve must be manually opened — it can only be opened and remain in the open latched position when the solenoid is energized. When the solenoid is de-energized, the valve will trip closed.

- **Dependable Control by ASCO.**

  The ASCO Bulletin 8022 comes in sizes ¾" through 6", with pressures ranging from 25 to 150 p.s.i. It has been designed to permit mounting in any position. This eliminates piping problems that occur with valves that must be mounted in one position. Valves are available with general purpose, watertight or explosion-proof solenoid enclosures to meet any requirements.

  For further information, write for ASCO Bulletin 8022. Or call the ASCO Engineer. He can give you full data on this valve, and on ASCO's complete line of 2, 3, and 4 way solenoid valves.

- **Special Features**

  Auxiliary Switch for operation of controls and signals. Time Delay to prevent valve from closing on a momentary loss of power.

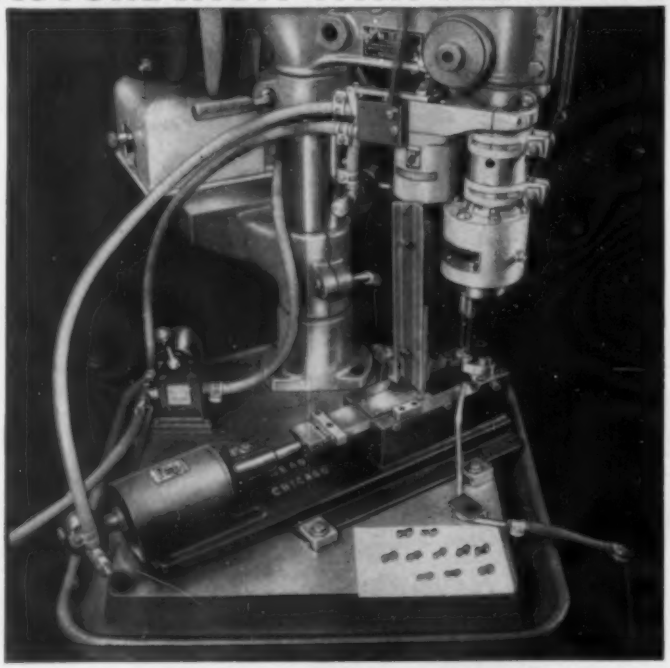
AUTOMATIC TRANSFER SWITCHES
SOLENOID VALVES ELECTROMAGNETIC CONTROL

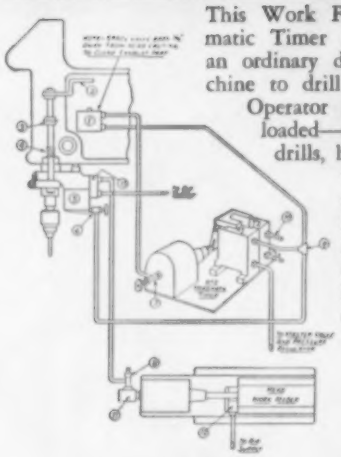
Automatic Switch Co.

50-B Hanover Road, Florham Park, New Jersey
FRontier 7-4600

ASCO

AUTOMATION WITH AIR POWER





This Work Feeder, with the aid of a Mead-matic Timer and Drill Press Feed, transforms an ordinary drill press into an automatic machine to drill twin holes in Chain saw links. Operator merely keeps the vertical hopper loaded—the machine delivers them to the drills, holds them firmly and ejects them when finished. Material is tough alloy steel, ranging in thickness from 1/8" to 1/4". Hole spacing is held to .0005" by bushings mounted in plate with micro adjustment. Production is 600 to 900 per hour, depending on thickness.

Write for free illustrated booklet of 44 "Examples in Air Power Automation".

MEAD

MEAD SPECIALTIES COMPANY
4114 N. Knox Avenue, Dept. AH-47, Chicago 41, Illinois

PATHFINDER IN AIR POWER AUTOMATION

Future Events

April 8-12: Annual National Spring Meeting of the American Welding Society. Hotel Sheraton, Philadelphia. For information write Robert T. Kenworthy, Exposition Management 12 East 41 St., New York 17, N. Y.

April 22-24: Vickers 1957 Turbojet Engine Hydraulics Symposium, Hotel Statler, Detroit, Mich.

April 29: Meetings of SAE Committee A-6 during this week, at the Sheraton-Plaza Hotel, Boston.

April 29-May 3: National Materials Handling Exposition, and 7th National Materials Handling Conference of the American Material Handling Society, Convention Hall, Philadelphia, Pa.

May 8-11: Spring Meeting of The Fluid Control Institute, Inc. Greenbrier Hotel, White Sulphur Springs, W. Va.

May 20-23: ASME Second Design Conference, held in conjunction with Design Engineering Show, New York Coliseum.

June 9-14: Third Annual Automation Seminar, Pennsylvania State University, University Park, Pa. For complete information and registration contact Chester Linsky, assistant professor of industrial engineering.

September 9-12: SAE Tractor Meeting and Production Forum, Hotel Schroeder, Milwaukee, Wis.

September 9-13: 12th Annual Instrument Automation Conference and Exhibit of The Instrument Society of America. Public Auditorium, Cleveland, Ohio.

October 1-5: SAE Aeronautic Meeting, Aircraft Production Forum and Aircraft Engineering Display, The Ambassador, Los Angeles, Calif.

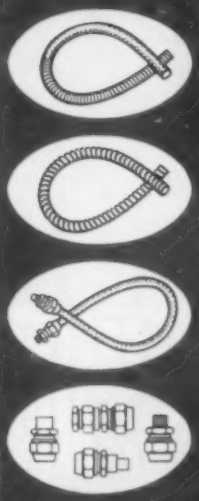
October 17-18: The 13th Annual Conference on Industrial Hydraulics. Hotel Sherman, Chicago, Illinois. Raymond D. Meade is Conference Secretary. ▼▼▼

with the acquisition of FLEX-O-TUBE...

FLEXONICS CORPORATION

now offers the FIRST COMPLETE LINE
of flexible hose products in all materials

FLEXON®
Metal Hose and Fittings



CORRUGATED HOSE
Flexon corrugated hose is the standard of the industry. Available in a variety of types in stainless steel, steel, bronze, alloys.

CONVOLUTED HOSE
Manufactured by Flexonics Corporation for over 35 years, Flexon convoluted hose is made in all commonly used types and materials.

HOSE ASSEMBLIES
A wide range of standard and special hose assemblies are manufactured by Flexonics Corporation to meet industrial requirements.

FITTINGS
A complete selection of couplings and fittings are offered for use with all types of Flexon metal hose for all services.

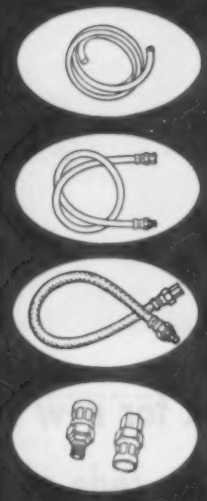
FLEX-O-TUBE®
Rubber and Synthetic Hose and Fittings

BULK HOSE
Flex-O-Tube bulk hose is offered in a wide range of types and sizes for handling liquids and gases for automotive, aircraft and industrial services.

HOSE ASSEMBLIES
Complete hose assemblies are furnished with a broad choice of standard and special fittings for low, medium and high pressures.

TEFLON HOSE
Teflon hose and hose assemblies are offered for use where chemical and temperature resistance and light weight are required.

FITTINGS
Reusable, pressed on, clamp type, flange type, S.A.E. and special fittings and couplings are manufactured for all services.



Now at your service are the combined know-how and engineering and manufacturing facilities of two leading manufacturers of flexible tubing. For you, it means better service on all your fluid conveying problems.

In joining forces with Flex-O-Tube, Flexonics Corporation now offers combined experience totalling 85 years. The combined field sales and service organizations operate through 15 offices in principal industrial cities with representatives in scores of additional centers and in thirty foreign countries.

Now more than ever before it will pay you to bring your fluid conveying problems to Flexonics Corporation—the one manufacturer who can answer virtually every need.

PLANTS AT
Maywood, Illinois • Inkster, Michigan • Elgin, Illinois • Memphis, Tennessee • Rock Falls, Illinois • Savanna, Illinois • Elizabeth, New Jersey • North Hollywood, California • Brampton, Ontario • Windsor, Ontario

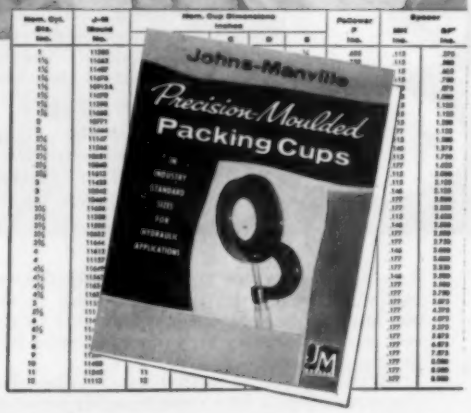
H-1

Flexonics Corporation
CHICAGO METAL HOSE DIVISION
FLEX-O-TUBE DIVISION

General Offices: 1385 S. Third Ave., Maywood, Ill.
In Canada: Flexonics Corporation of Canada, Limited, Brampton, Ontario

Also Manufacturers of
Expansion Joints • Bellows • Thermostats • Aircraft Assemblies and Components

Packing Cups in Industry Standard Sizes Precision-moulded by Johns-Manville



Ask for new size list and compound color code of these J-M Packing Cups

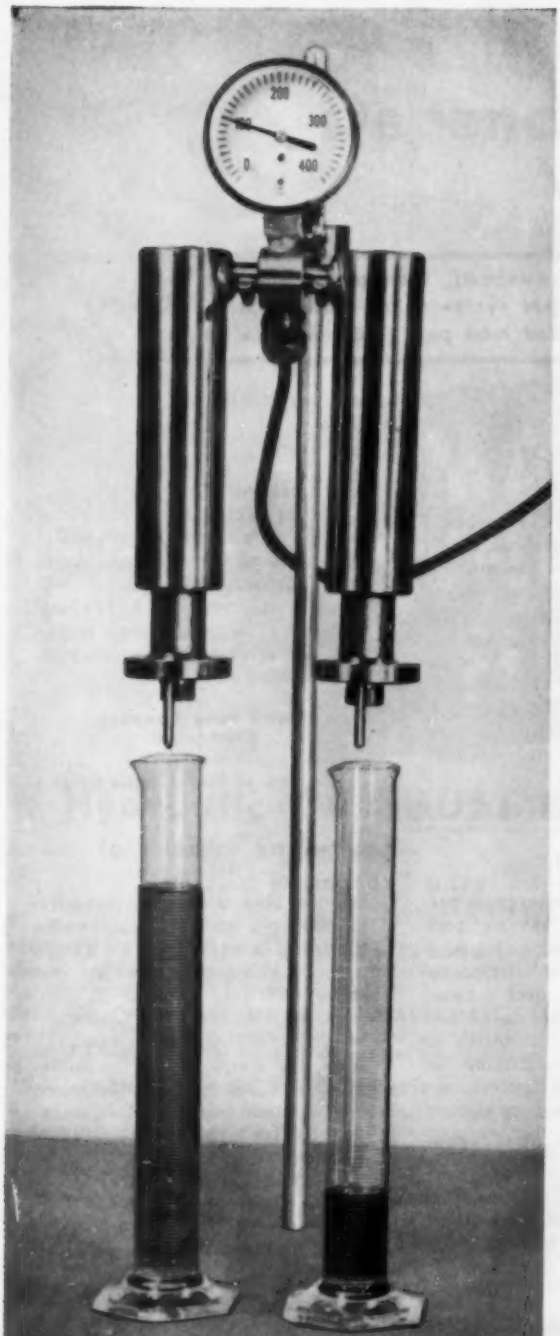
Made in the original *square heel* design, developed and perfected by Johns-Manville, these cups are precision made to assure maximum efficiency.

They are available in a variety of styles and compounds to suit most pressures, temperatures and fluids. For easy identification, cups are marked with a different color stripe for each compound.

Complete dimensions, compounds, code and piston design data are in folder PK-107A. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ont.

Johns-Manville PACKINGS, GASKETS and TEXTILES

Circle 61 on Reader Service Card



Less oil loss with Suntac is proved by this leakage demonstrator. Suntac oil is placed in one chamber, a straight mineral oil of the same viscosity in the other. Both oils are pressured through sintered bronze bearings. At 100 psi the straight mineral oil leaks out four times faster than Suntac.

LEAKAGE DEMONSTRATOR PROVES SUNTAC CAN CUT OIL LOSS AS MUCH AS 75%

Expensive equipment overhauls to stop leaks in hydraulic systems can often be avoided by a change to Suntac®. The exceptional antileak characteristics of Suntac oils can reduce oil losses as much as 75%, as can be proved in the leakage demonstrator. *Some users have reported actual drops in oil leakage of 90%.*

Suntac oils give you lower lubrication costs, cleaner equipment and floors, safer working conditions. Their leak-reducing agent leaves no gummy film or residue. In addition, Suntac oils are fortified against oxidation to lengthen oil life...against rust and corrosion to lengthen equipment life.

You'll find Suntac a money and time saver in your hydraulic systems...and a high-quality general-purpose oil for many other uses.

WANT MORE SUNTAC FACTS? Ask your Sun representative for Technical Bulletin 23. Or you can get full details, prices, and delivery information by writing to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. AH-4.

SUNOCO

©Sun Oil Company

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

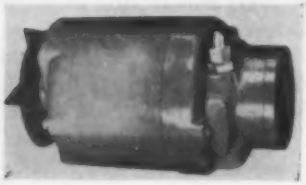
Philadelphia 3, Pa.

In Canada: Sun Oil Company Limited, Toronto & Montreal

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

PUMP-MOTOR COMBINATION . . . is small and light



Designation: Powermite

Features: Developed for unusual space and weight limitations, model illustrated combines a positive displacement, internal gear rotary pump; a driving motor; and a cooling blower in a space measuring only 8-1/2 by 4-3/4 in. A single shaft serves all units of the Powermite. Substantial economies are possible through elimination of couplings, other parts, and assembly time and labor costs.

Specifications: Unit can be furnished in large production runs only, in a wide variety of pump and motor combinations. Model shown delivers 0.30 gpm at 300 psi, and is driven by a 1/12-hp motor at 1750 rpm. A shaft extension, for driving other accessories, can be supplied.

Tuthill Pump Company
Chicago, Ill.

Circle 145 on Reader Service Card

TEFLON HOSE ASSEMBLIES . . . feature small OD

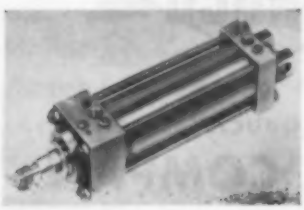
Features: High tensile strength permits smaller OD, saving both weight and space, and giving high resistance to vibration. Teflon retains high flexibility over a broad range of conditions and resists chemicals, oils and corrosives at elevated temperatures, making the hose suitable for fluid power applications under severe conditions. Operating and shelf life are practically unlimited.

Specifications: Constructed of smooth, extruded Teflon tube, with stainless steel wire braided covering, the hose withstands pressures to 3000 psi under certain conditions, and temperatures to 500 F, when working pressures are not above 1000 psi. Available in sizes from 3/16 to 1-1/8 in. with conventional straight and elbow fittings, and special shapes, in aluminum alloy for lower temperatures and cadmium-plated steel, or stainless steel for high temperature, high pressure applications.

Flexonics Corporation
Flex-O-Tube Division
Maywood, Ill.

Circle 146 on Reader Service Card

AIR & OIL CYLINDERS . . . quick-change rod packing



Designation: Squarehead S

Features: Rod ends feature a quick-change rod cartridge, solidly locked to the head by a tightly coiled stainless steel spring which is seated in matching grooves in the head and cartridge. By removing one screw, this spring can be stripped out and the rod cartridge removed, allowing replacement of a worn rod seal or the rod cartridge.

Specifications: Units are rated at 250 psi for air or 1000 psi for oil, in seven bore sizes up to 6 inches. Tubes are chrome-plated steel, with chrome-plated, manganese-steel piston rods. Tie rods are pre-stressed and full floating cushions are provided. Cylinders are designed and built to JIC standards.

Lindberg Air and Hydraulic Div.
Teer-Wickwire & Co.
Jackson, Mich.

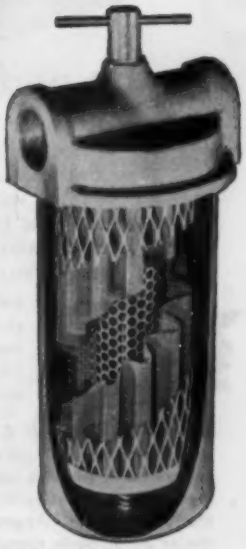
Circle 147 on Reader Service Card

Continued on page 54

SUMP TYPE

For Dependable Protection on HYDRAULIC EQUIPMENT

MARVEL SYNCLINAL FILTERS



LINE TYPE (Cutaway)

Hydraulic Oils MUST BE CLEAN!

to Protect Equipment—
Increase Production—
Reduce Maintenance

PRODUCTION ENGINEERS and MAINTENANCE MEN, whose job it is to keep production machinery operating at peak efficiency, are specifying Marvel Synclinal on new equipment and standardizing with Marvels throughout their plants.

OVER 750 ORIGINAL EQUIPMENT MANUFACTURERS of hydraulically actuated equipment or machines utilizing low pressure liquid circulating systems, also recognize the superiority of Marvel Synclinal Filters in serving this purpose and are installing them as standard equipment.

It's The ACTIVE Filtering Area That Counts!

The synclinal design of Marvel Filters provides that all-important balance between maximum ACTIVE filtering area and sufficient storage capacity for filtered out particles. Thus, longer periods of productive operation are attained before filter cleaning is necessary. Marvel Synclinal Filters are easy to clean because both the sump and line type may be disassembled, thoroughly cleaned and reassembled in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

Meet J.I.C. Standards

Catalogs containing complete data available on request

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G. P. M. Greater capacities may be attained by multiple installation (as described in catalog). Choice of monel mesh sizes range from coarse 30 to fine 200.

WATER FILTERS

Both sump and line type filters have been adapted for use in all water filtering applications. No changes have been made in the basic, balanced synclinal design.

IMMEDIATE DELIVERY!

As in the past, Marvel continues to offer Immediate Delivery

FILTERS FOR FIRE-RESISTANT HYDRAULIC FLUIDS

Marvels most recent development is a filter for the efficient filtration of all types of fire-resistant hydraulic fluids.

MARVEL ENGINEERING COMPANY

7227 N. Hamlin Ave., Chicago 45, Ill. **PHONE: Juniper 8-6023**

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated: (AH-4)

- ☐ Catalog #107—For Hydraulic Oils, Coolants, Lubricants.
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name _____ Title _____

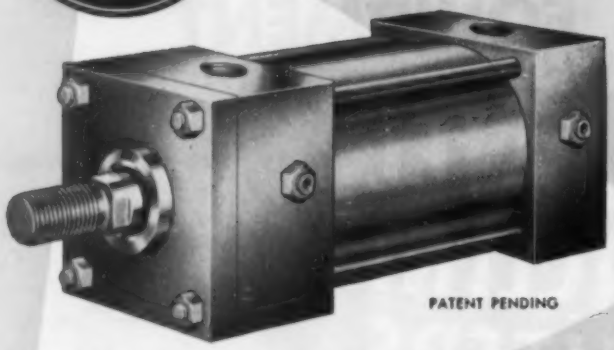
Company _____

Address _____

City _____ State _____

FOR AUTOMATION

S-P CYLINDERS



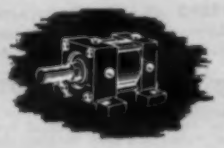
PATENT PENDING

top performance–longest life

All S-P cylinders are engineered throughout for high speed, efficient operation. Piston rods are heat treated and hard chrome plated to resist scoring. Bronze cartridges with extra long bearing surfaces are easily removable for quick servicing of rod seals and wipers. End plates are rolled steel. All S-P cylinders are built to JIC standards.

S-P STANDARD AIR CYLINDERS have brass tubes to eliminate corrosion. Cushions float on O-rings for maximum cushioning. Eleven bore sizes, 1½" — 14". 21 mounting types. Readily modified for oil or water. Send for Catalog No. 110.

S-P HEAVY DUTY AIR CYLINDERS for automation and other severe applications. Double porting for extreme high speeds. Heavy wall seamless steel tube. Nine bore sizes, 1½" — 8". Five mounting types. Approved and used by two major automobile manufacturers. Send for Catalog No. 109-A.



S-P HIGH PRESSURE HYDRAULIC CYLINDERS have seamless steel tube. Special locking mechanism eliminates tie rods. Designed for 2,000 psi. Eleven models in 11 sizes. Send for Catalog No. 104.

Step up production with S-P cylinders. Representatives in principal cities. Prompt deliveries. Order catalog by number shown above. The S-P Manufacturing Corporation, 30201 Aurora Rd., Solon, Ohio. *In greater Cleveland.*

SPecify SP

THE S-P MANUFACTURING CORP.

SOLON, OHIO • *IN GREATER CLEVELAND*

ESTABLISHED 1916 A BASSETT COMPANY

NON-ROTATING AIR AND HYDRAULIC CYLINDERS • ROTATING AIR AND HYDRAULIC CYLINDERS
POWER CHUCKS • COLLET AND DRILL PRESS CHUCKS • AIR PISTONS, VALVES, ACCESSORIES

New Products continued

NAME PLATE
. . . identifies components

Features: Developed for identifying control panel components, such as relays, starters, timers, these plates may also be used to identify motors, limit switches, terminal boxes and other equipment mounted on machinery. Special adhesive on the back of each plate permits fast, easy application. Plates form a strong, permanent, heat resisting bond when applied to any surface. Elimination of drilling, tapping and threading reduces costs on production identification jobs.

Specifications: Units are available in either fibre or aluminum. On the fibre plates letters or numbers are clearly engraved on dark background. On aluminum plates letters are white on black, anodized background. Plates are ⅜ in. high and 1 in. wide.

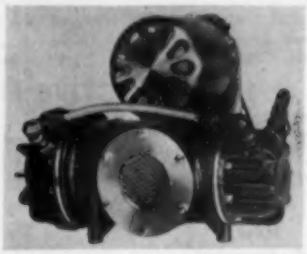
E. C. P. Corp.
Cleveland, O.

Circle 148 on Reader Service Card

AIR PUMP
. . . is diaphragm type

Designation: Series 283

Features: Diaphragm construction eliminates pistons and cylinders with their related problems of friction, heat, lubrication, carbon dust



and loss of capacity with wear.

Specifications: Pump weighs only 6.5 pounds. Provided with ac or dc motor drive, and with gage or absolute pressure switch; relief valve or combination vacuum-pressure relief valve; check valve and chemical dehydrator. All air entering the unit is filtered.

The Cornelius Co.
Minneapolis, Minn.

Circle 149 on Reader Service Card

For more NEW PRODUCT reviews turn to page 124

Why Parker O-rings seal better and last longer!

For trouble-free leakproof sealing, you can depend on precision-molded Parker O-rings. Laboratory and service tests check every detail of the manufacturing process. Precision-molding by exclusive methods assures accurately sized O-rings. And we have molds for over 296 standard O-ring sizes!

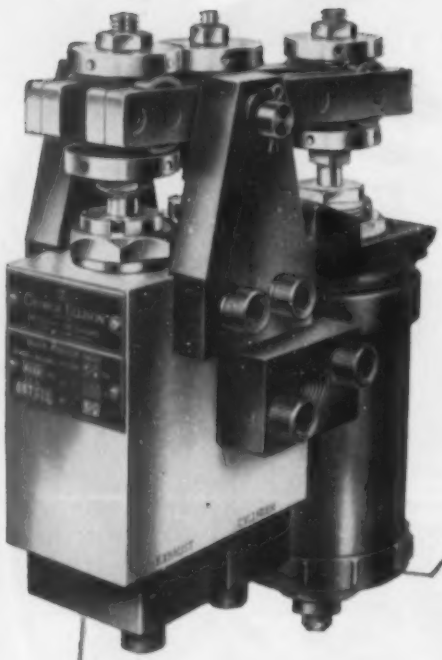
From Parker you get exactly the *right* O-ring for your *specific* application. We invite you to prove by comparison tests how Parker O-rings seal better and last longer. Our engineering service will be glad to help you with designing problems. Mail the coupon or ask your Parker O-ring distributor for catalog.

Parker
Hydraulic and fluid system components

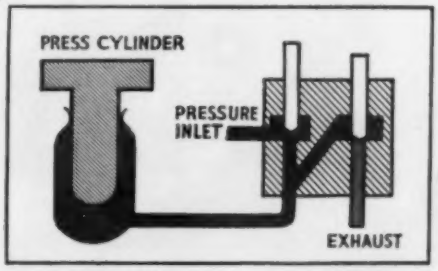
RUBBER PRODUCTS DIVISION
Section 521-A
The Parker Appliance Co.
17325 Euclid Ave., Cleveland 12, Ohio

☐ Please send O-ring Catalog No. 5701

NAME_____
COMPANY_____
ADDRESS_____
CITY_____ STATE_____



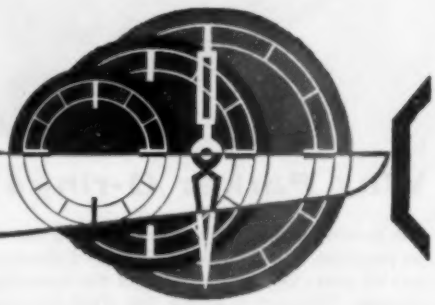
AUTOMATIC CONTROL at low cost



Plain upstroking press working on one fluid pressure with gravity return of the ram.

With very little capital outlay beyond the purchase of a few Ellison valves and suitable timing instruments, many factories can provide themselves with a very effective form of automation. Such an installation enables several hydraulically operated machines to be controlled automatically by a single operator and could well be applied to the automatic control of safety devices and guards.

Ellison valves in themselves mark a real step forward in hydraulic practice, embodying new features to prevent scoring of seats and stems and to ensure trouble-free service with little maintenance. Ask for full details.



Made by

GEORGE ELLISON
LIMITED

PERRY BARR BIRMINGHAM 22B
ENGLAND

808

See them Now!

Industry's MOST WANTED line of GENERAL PURPOSE VALVES

FOR PETROLEUM REFINERIES
CHEMICAL PLANTS • POWER PLANTS

Write for Supplement No. 1 to Catalog F-9
Address Dept. 24A-FAH

MOST WANTED — that's right — because the G P line includes gate, globe, and angle type valves having seats faced with **HAYNES STELLITE*** alloy or other hard facing alloys for greater seat-wear resistance . . . at no extra cost!

Hard faced seats, in combination with precision finished, selectively hardened discs and wedges give these valves amazing resistance to erosion, corrosion and galling. That's why they are setting new standards of performance in steam, water, oil, or gas services at the recommended pressures and temperatures.

Get longer, drop-tight, service life with minimum maintenance by specifying Vogt G P Valves. Available in a complete range of sizes from ¼" to 2" and rated 800 pounds at 850°F. and 2000 pounds at 100°F.

HENRY VOGT MACHINE CO.
P. O. Box 1918—Louisville 1, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati, San Francisco

Vogt — GENERAL GP PURPOSE — Vogt FOR BETTER VALVES

DROP FORGED STEEL

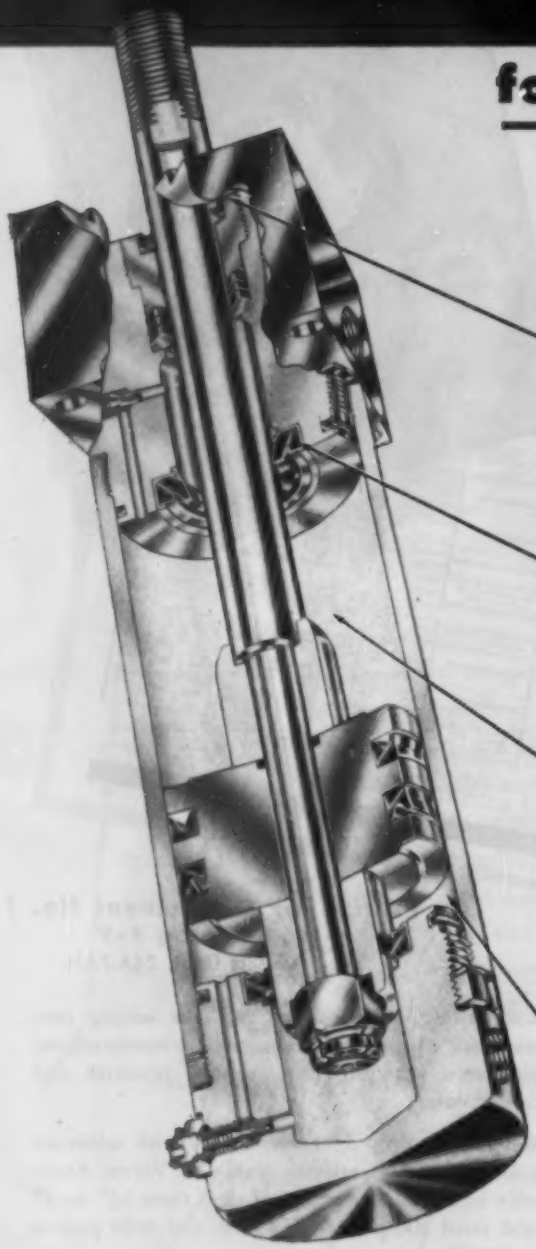
VALVES

*Trade-Mark of Union Carbide and Carbon Corporation

Need a cylinder today?

for all these Extras . . .

T-J Spacemaker



PISTON ROD SCRAPER . . . Not just a felt or fabric wiper, but a metal to metal contact. Protects rod packing and cylinder bores at all times by actually removing foreign particles from piston rod surface. STANDARD AT NO EXTRA COST!

NEW "SUPER" CUSHION FOR AIR . . . Of T-J design and patent, it assures millions of trouble-free cycles. Years of T-J research and test have answered the problem of "how to make a cushion last". All T-J cushions are adjustable, STANDARD AT NO EXTRA COST!

CHROME PLATED CYLINDER BORES AND PISTON RODS . . . The piston rod, of course. But of these two features, the chrome plated bore is by far the most important, due to the much greater area that is subject to wear. Chrome plating of bore gives extra protection where needed most. Also a protection from condensation and foreign matter, that may find itself into the system. STANDARD AT NO EXTRA COST!

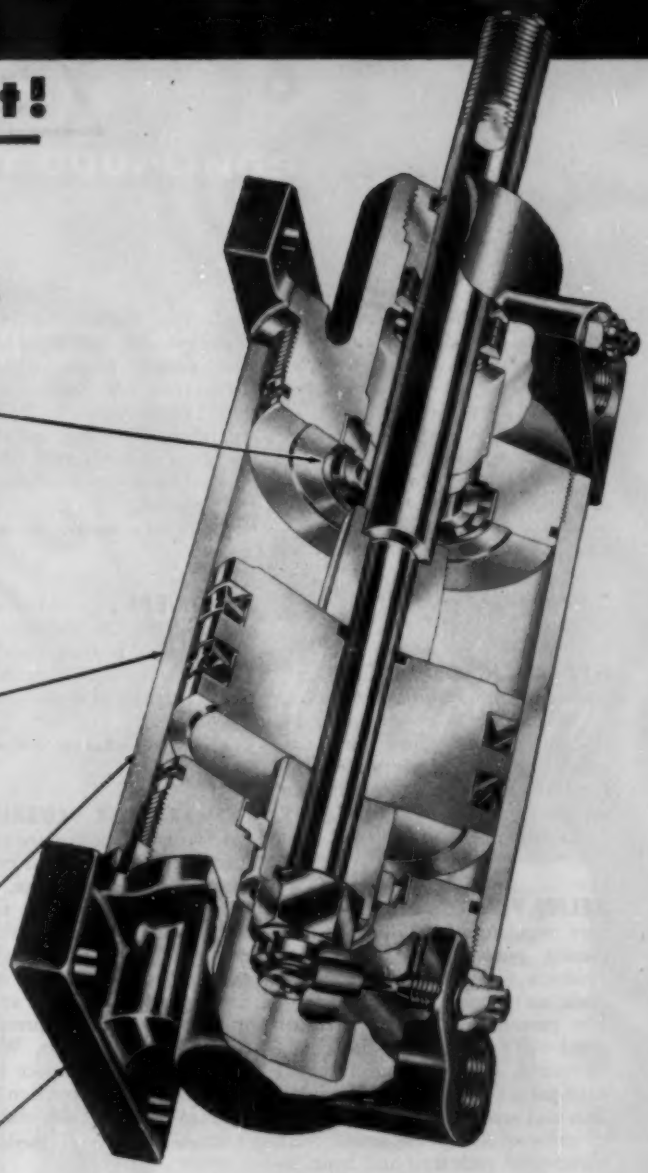
ONE PIECE PISTON . . . Giving you three point surface bearing which increases the distance from the piston end to the rod bearing. This T-J feature assures better alignment, longer bearing and packing life. STANDARD AT NO EXTRA COST!

off shelf delivery

. . . Just call T-J

at no Extra Cost!

cylinders



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Useful Literature

For your free copy of publications reviewed, fill in the reader service card

HOSE ASSEMBLIES . . . for hydraulic service are illustrated and described in catalog issued by Pyles Industries, Inc. Units are of steel, two-piece construction with stem and ferrule permanently locked in assembly. Deep, opposed barbs mechanically create chevron-type seal. Available in any specified length in hose sizes from ¼ to 1 in. ID. Line includes male and female steel adaptor unions.

Circle 200 on Reader Service Card

HYDRAULIC CYLINDERS . . . one and two-way types, from 1⅞ to 10 inch OD, are produced by Hydraulics Unlimited Mfg. Co. Available literature gives specifications and engineering information on units for service at 1000 psi.

Circle 201 on Reader Service Card

RELIEF VALVES . . . and air pressure regulators are illustrated in catalog published by Accessory Products Corp. Items covered include air pressure regulators, absolute pressure regulators, flapper check-valve assemblies, relief valves, variable, manually-controlled, and high-pressure regulators. Technical data and specifications are given in a series of design bulletins, with sketches of each unit and basic information in convenient tabular form.

Circle 202 on Reader Service Card

FLEXIBLE COUPLINGS . . . consisting of a double strand of roller chain which holds together two, single-width sprockets, are available from Chain Belt Company's Roller Chain Div. Bulletin 54-7 discusses twin-flex, semi-flex, compound and dummy-shaft couplings, giving information on their use, which should be of interest to fluid power engineers. Complete specifications are given in easily read tables, and application of the couplings is clearly illustrated.

Circle 203 on Reader Service Card

AIR DRIERS . . . and other products made by The McIntire Company are listed in their Catalog R-9. Line includes liquid line driers, filters, strainers and replacement flexible hose.

Circle 204 on Reader Service Card

COMPRESSOR LUBRICANTS . . . fire-resistant type to minimize the problem of fire and explosions in air compressor service, are produced by Celanese Corp. of America. Theory of fire-hazards is covered in their booklet, and use of their product, Cellulube, to reduce the dangers. Also given are the results of tests on compression-ignition and auto-ignition. Wear data is given based on service tests, and information on conversion from petroleum lube to Cellulube.

Circle 205 on Reader Service Card

ELECTRIC DRIVES . . . featuring infinitely variable, fingertip speed control for powering hydraulic systems, are manufactured by Sterling Electric Motors. Available booklet discusses models for various applications, including remote and automatic units. Complete engineering data is given on the units and features, along with helpful information on variable speed control.

Circle 206 on Reader Service Card

STEEL O-RINGS . . . provide leakproof face-seals for oil or air at temperatures from —300 to 2000 F. Booklet available from D.S.D. Manufacturing Company illustrates their Toruseal, stainless steel O-rings. Tables are given covering general information and dimensions.

Circle 207 on Reader Service Card

MANIFOLDS . . . for individual and multiple valve mounting are covered in Bulletin H55 issued by Petch Mfg. Co. Threadless subplates for gasket-mounted valves are described and illustrated. Information and specifications are also given on related products, such as hydraulic control units, panels, tube assemblies and junction blocks.

Circle 208 on Reader Service Card

HYDRAULIC PUMPS . . . and motors, heavy-duty, axial-piston-type, are featured in Catalog 200 published by Waterbury Tool Div. of Vickers Inc. Booklet discusses the variable and reversible pump and a cutaway illustrates all the working parts. Complete engineering data is given on their pumps, hydraulic motors, transmissions and controls. An added feature is a large picture of a pump and drive system on a huge tube-reducing machine with a cutaway section of one of the pumps.

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For more reviews of FREE LITERATURE turn to page 143

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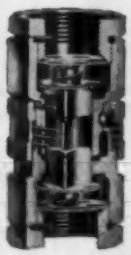

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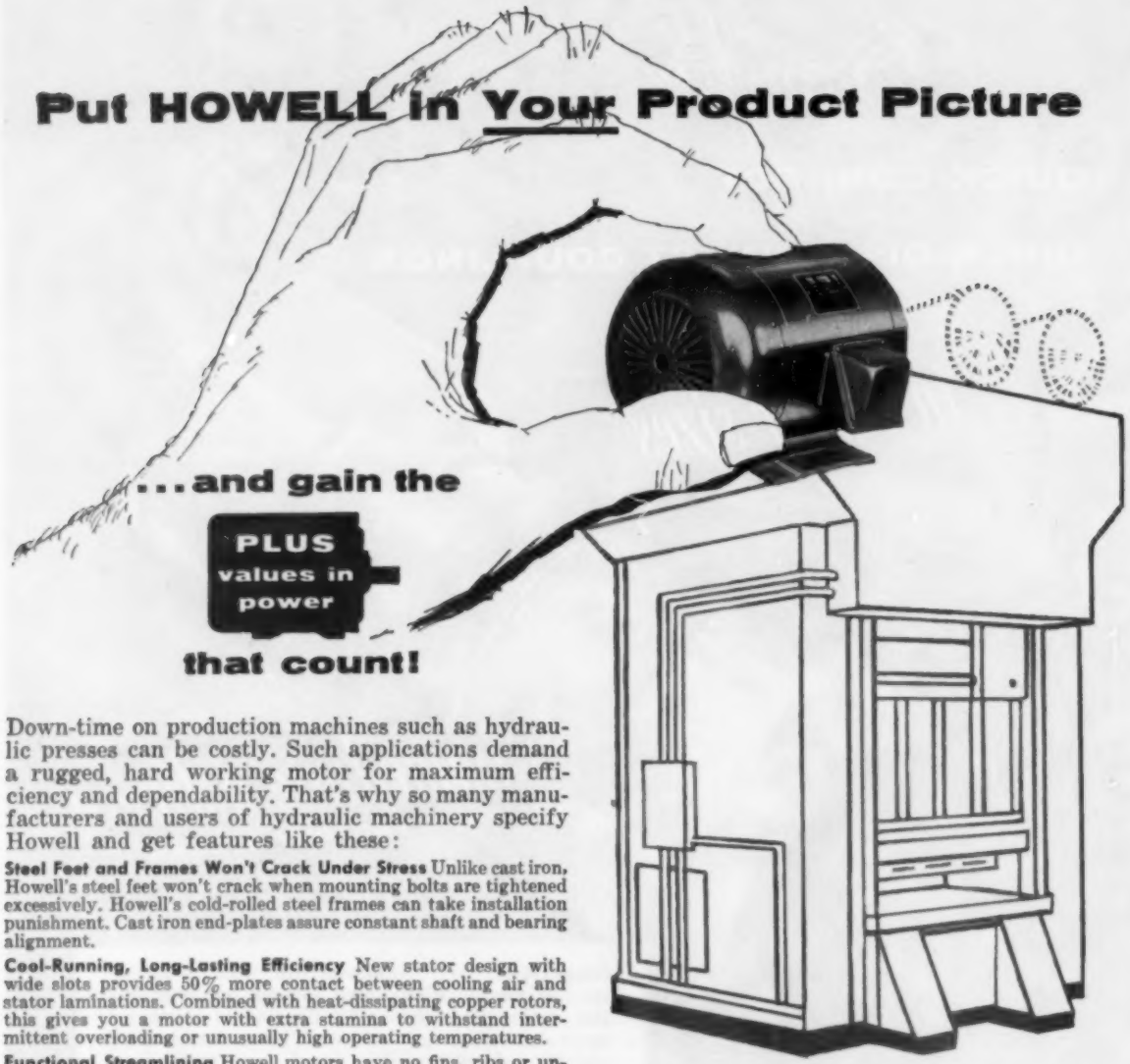

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Down-time on production machines such as hydraulic presses can be costly. Such applications demand a rugged, hard working motor for maximum efficiency and dependability. That's why so many manufacturers and users of hydraulic machinery specify Howell and get features like these:

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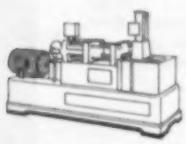

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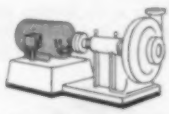
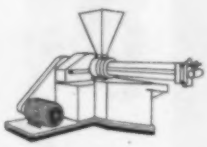
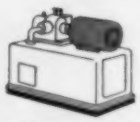


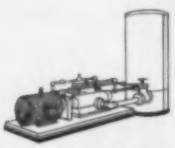
FLUID TRANSMISSION PUMPS



EXTRUDERS



HYDRAULIC SYSTEMS



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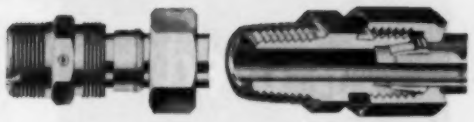
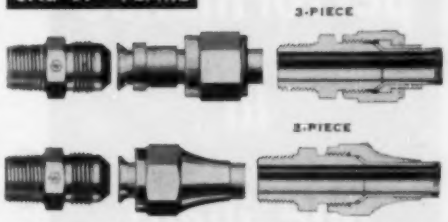
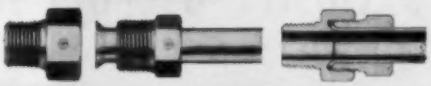


SAE 37° FLARE



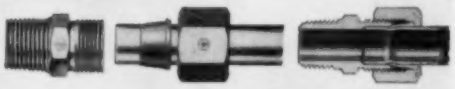
SAE 45° FLARE

INVERTED FLARE



COMPRESSION

SELFALIGN



PIPE

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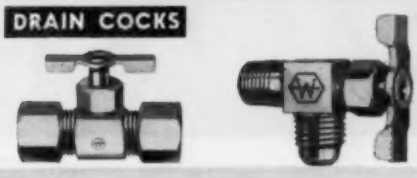

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Circle 133 on Reader Service Card

proved performance in one plant led to exclusive use of *Texaco Regal Oil R&O* in another

Here's an excellent example of why the nation's largest users of hydraulic oils have come to standardize on *Texaco Regal Oil R & O*.

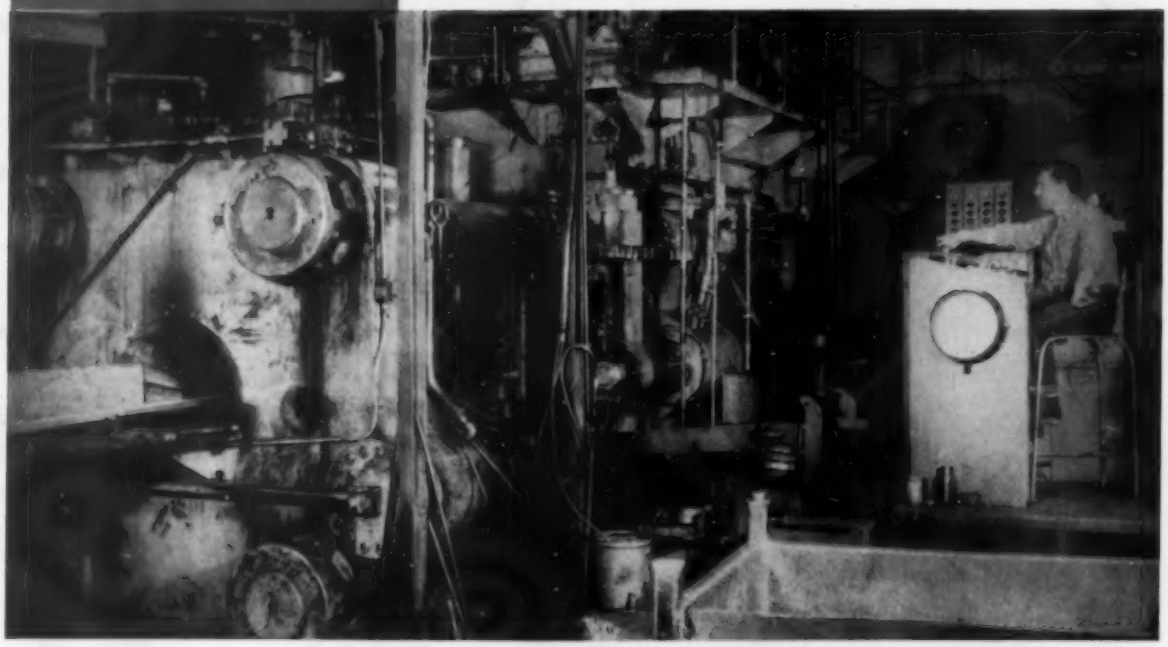
This company (name on request) first used *Texaco Regal Oil R & O* in its midwest plant. The results were outstanding. This great oil kept press systems clean—free from rust, sludge and foam—prevented wear.

Then the company tried the same oil in a huge Navy Industrial Reserve Ordnance plant it operates. This second plant has a large number of Bliss and HPM cold-shaping presses and hydraulically-operated Heller cut-off saws. The presses alone have a total hydraulic oil capacity of 65,000 gallons.

Again, *Texaco Regal Oil R & O* proved efficient and trouble-free. Run-in tests proved it keeps hydraulic systems exceptionally clean—enabling them to operate at peak efficiency. As a result, this one oil is now used as the sole hydraulic medium throughout the plant.

There is a complete line of *Texaco Regal Oils R & O* to meet every hydraulic requirement. Ask a Texaco Lubrication Engineer to help you select the one best for your systems. He's specially trained in hydraulic applications.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.



Every press in this plant uses *Texaco Regal Oils R & O* exclusively because it keeps systems clean—free from rust, sludge and foam. Presses range in size from 500 to 2,000 tons.

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TUNE IN . . . METROPOLITAN OPERA RADIO BROADCASTS EVERY SATURDAY AFTERNOON

Synchronizing the four cylinders of this drilling machine was complicated by the uneven loading during the work stroke. The solution is a special cylinder which equalizes output from each main cylinder.

SYNCHRONIZE 4 CYLINDERS

... with unequal loading

TWO OF THE FOUR CYLINDERS which feed the work piece up against the 400 drills can be seen mounted under the ram. Two limit switches shown at left control solenoid valves which connect a synchronizing cylinder into the circuit.

● By James Tankard

SYNCHRONIZING the speed of cylinders has always been a problem to designers of hydraulic machinery. When only two cylinders are involved, various mechanical and hydraulic arrangements have been used with some success. However, where several cylinders are to be synchronized, where they are far apart, or where loads are high and unequal, these methods are seldom effective. Recent developments in electronic feedback controls using servo valves have made it possible to control cylinder movement very closely. However, the present cost

JAMES TANKARD, *Product Engineer, Zagar, Inc., Euclid, Ohio*

of such equipment is high, and many jobs do not warrant the expenditure.

One of the difficulties of synchronization has been leakage, and as long as cylinders are built which permit oil to leak past the piston, this problem will exist. This leakage varies from cylinder to cylinder and it changes with varying pressures. It can become extreme when unequally loaded cylinders are required to move together.

The engineering department of Zagar, Inc. was recently faced with this problem. The solution is not a cure-all, nor is it practical in all applications, but it was effective in the design of a multiple drilling machine developed by the company.

The job for which this machine was designed was to drill large, cast iron piano frames on a production basis. Each frame has over 400 holes which vary in size from No. 29 to 7/16 inch. About 200 or more of the large holes were in a long cluster along one edge of the frame.

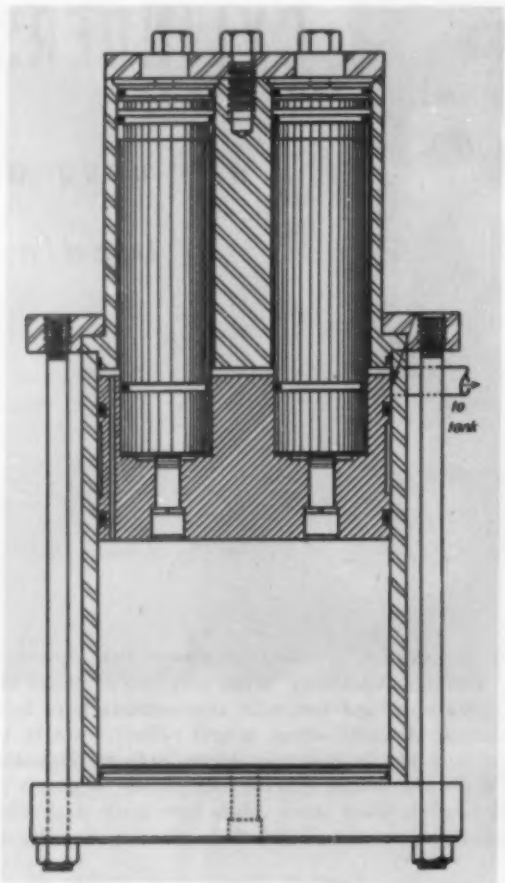
It was decided to do this job in one pass using a massive close-center gearless drill head. The frames are mounted on a 4-post, ram-type machine. The ram is raised by four 8-inch diameter cylinders mounted at the four corners. The ram has rectangular dimensions of about 40 x 60 inches and weighs over one ton. The thrust required for drilling is about 25,000 lb.

During the rapid travel part of the 8-inch stroke, the load on each cylinder is equal. During the drilling part of the cycle, the cylinder with the heaviest load must exert eight times the force of the lightest loaded cylinder.

It was, of course, impossible to operate under these conditions without close synchronization of cylinder travel.

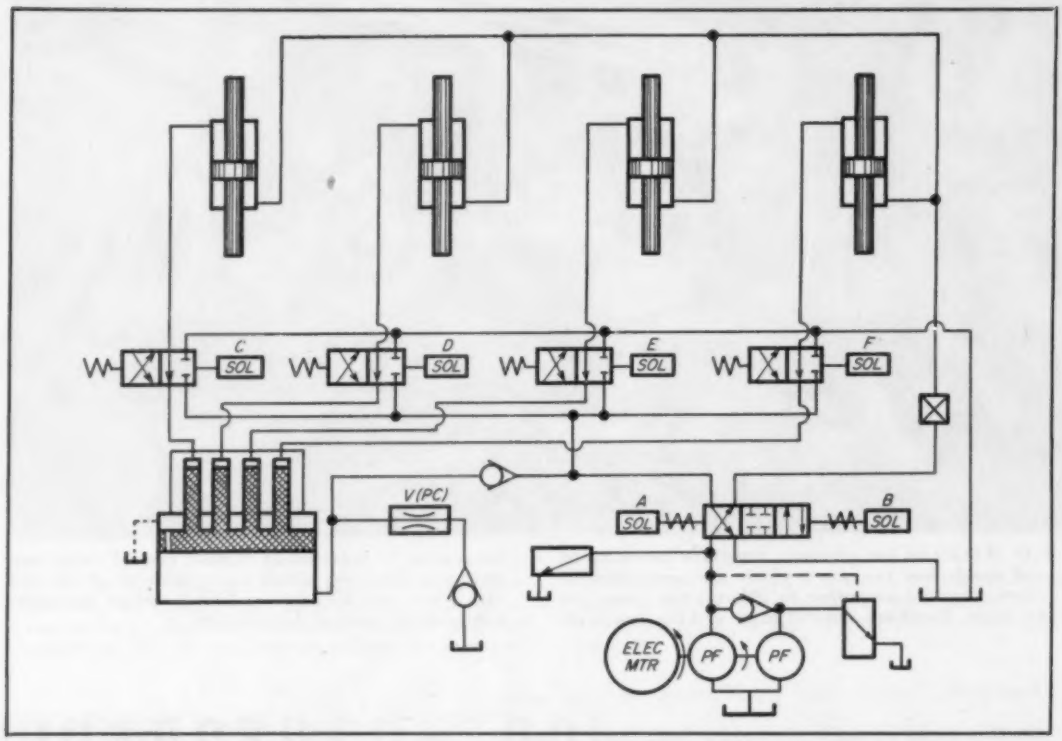
The first method used to solve this problem was to connect a standard pressure-compensated flow control valve at the outlet of each cylinder. One difficulty of this design was that the volume of oil being metered out was very small, preventing accurate control. Because of oil viscosity changes as it heated up, it was necessary to adjust the flow control valves each day at the beginning of operation. As the drills became less sharp, the unbalance became exaggerated, requiring continual adjustments of the flow control valves.

Going to an entirely different arrangement to



CROSS SECTION of special synchronizing cylinder shows two of the four pistons which are bolted to a main piston. The vent through the main cylinder allows enough oil to escape during each stroke to keep any air from accumulating.

POWER UNIT for the machine includes a combination pump with outputs of 18 and 1.5 gpm connected in a hi-lo circuit. Pressure setting for the low pressure pump is 375 psi; pressure setting for the high pressure pump is 700 psi.



FOUR CYLINDERS are piped in series with separate sections of synchronizing cylinder. Because the single piston of this unit serves all four sections, all of the main cylinders must move at the same rate. This rate is controlled by the flow control valve metering output from the synchronizing cylinder.

solve the problem, a special control cylinder was designed to replace the four flow control valves. This cylinder contains a piston which is actually five pistons in one. Four small pistons are bolted securely to one large piston. Oil which is exhausted from the top port of each of the four main cylinders is piped to the four connections on the control cylinder. This forces the control piston down, and as the oil leaves the bottom of the control cylinder, it is metered through a pressure compensated control valve. Except for leakage, it is impossible for the main cylinder pistons to move any faster than their corresponding small control pistons. Since the four small control pistons must move at the same rate because of mechanical lock, there is an equal movement of the main cylinders even under extremely unbalanced loads.

During rapid approach of the ram, the loads on the main cylinders are equal. The two-way solenoid valves controlled by the limit switches are deactuated and the control cylinder is not used. The full capacity of both pumps which are connected in a hi-lo circuit is used to give a rapid upward movement of the ram.

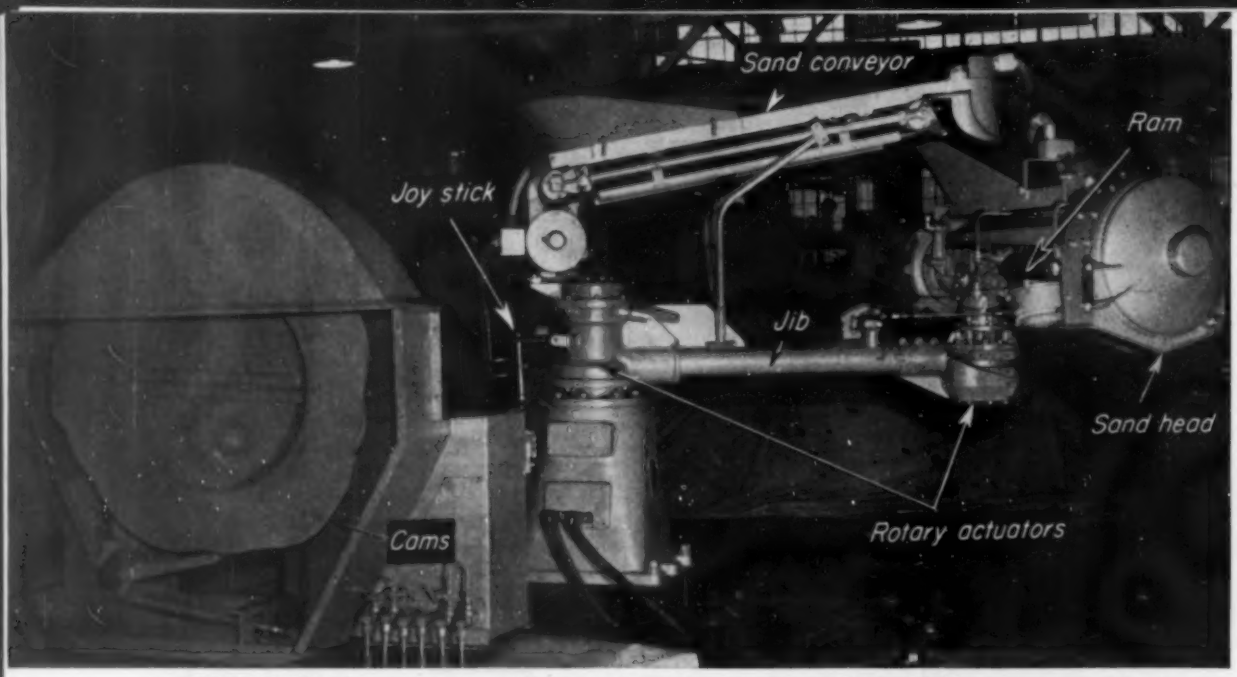
During the drilling part of the cycle, oil from the large pump is directed back to tank at near-zero pressure through an unloading valve. The small pump continues to supply oil to the four main cylinders through a common header. Oil from the four main cylinders is directed into the control cylinder by the 2-way solenoid valves.

At this point, there are four closed circuits in operation. The top port of each main cylinder is connected to its own individual section of the control cylinder. Oil from the bottom of the control cylinder is metered through the pressure-compensated flow control valve.

During the first part of the rapid return stroke, oil is forced into the bottom of the control cylinder, thus replenishing this part of the circuit each cycle. The top area of the main control piston, is vented to tank under no pressure. When the 2-way solenoid valves are deactuated to their spring-loaded position, exhaust from the cylinders flows directly to tank.

In order to vent air from the bottom part of the control cylinder, a .150-inch diameter hole was reamed through the main piston. A pin on which a flat had been ground was then pressed into this hole. The flat is .005-inch deep. This allows enough oil to escape during each stroke to keep any air from accumulating.

With the use of this control cylinder the ram can move the entire stroke of eight inches under any unbalanced load within the capacity of the machine and remain horizontal within .003 inch per foot or 1/64 inch measured over the total 5-foot length of the ram. ▼▼▼



THE MACHINE for accurate, repetitive ramming of sand molds has two arms which are positioned by rotary actuators according to information stored on two cams. Feedback control to a walking beam arrangement is provided by remote control units consisting of receivers which sense position of jib and ram arms, and transmitters which actuate the walking beam to control 4-way valves.

Accurate, continuous positioning of the arms on this mold ramming machine required a servo system to control the 4-way valves. Previously cut cams provide the input signal, and a closed loop hydraulic system provides feedback. These signals are combined in a walking beam.

HYDRAULIC ... *with*

ROTARY ACTUATOR forms pivot between ram and jib arms and rotates ram in either direction through a total arc of 90 degrees. Direction and speed of actuator depend upon position of control valve spool. Remote control receiver is mounted on jib arm with its actuating lever connected to ram arm. This acts as a feedback unit to transmit the position of the ram unit back to the valve and to stop the ram unit at the required position. Throttling grooves on the valve control ram speed.

● By George Koren

TO PERFORM its function as a high production foundry, automatic mold ramming unit, the Beardsley and Piper Automatic Hydra-Slinger required accurate, speed-controlled movements of its two pivoting arms which position the sand expelling ram head over the mold area.

Basically, this has been accomplished by a combined hydraulic and mechanical system consisting of two of each of the following:

a. Rotary actuators mounted at the pivot of each moving arm

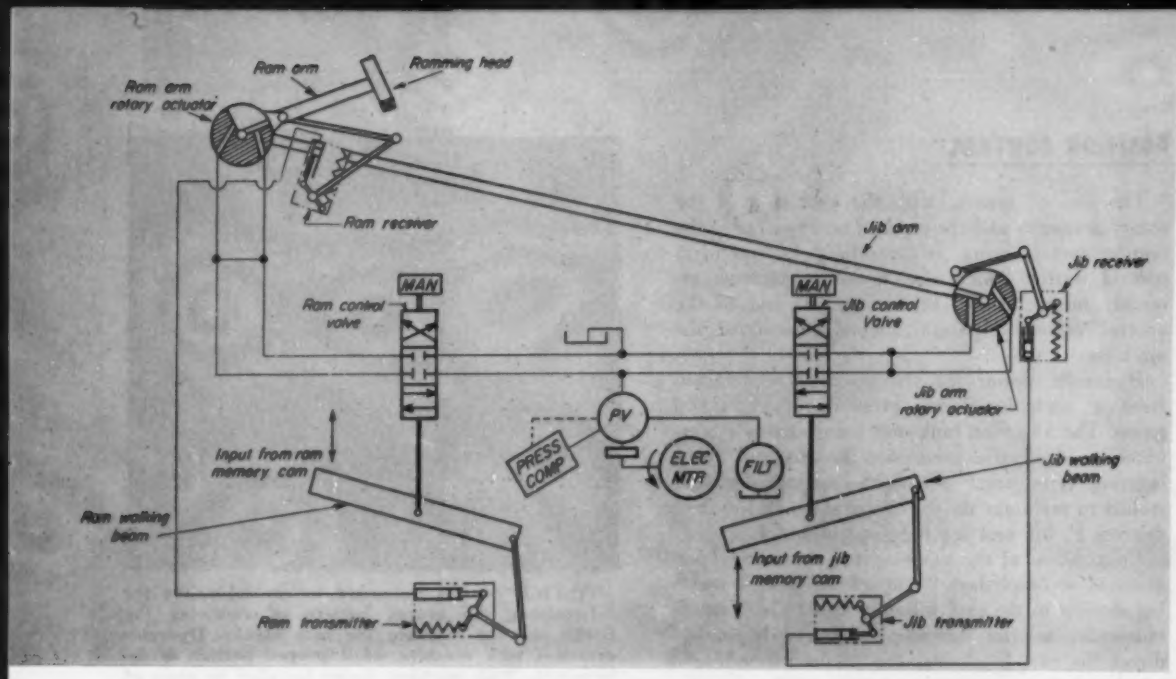
b. Four-way valves with tapered spools to control the oil flow to the rotary actuators

c. Control cams, which serve as memory devices

d. Mechanical linkages necessary to interconnect all of the control circuit components

e. Pairs of remote control units

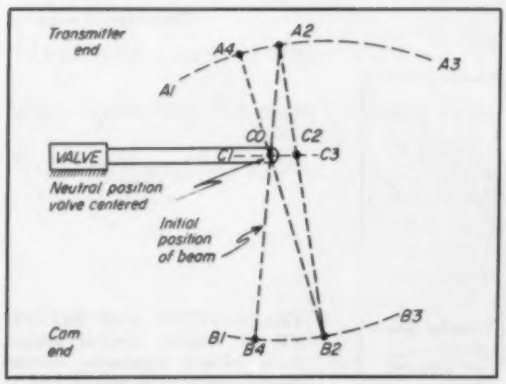
GEORGE KOREN, *Chief Research & Development Engineer, Beardsley & Piper Div., Pettibone Mulliken Corp.*



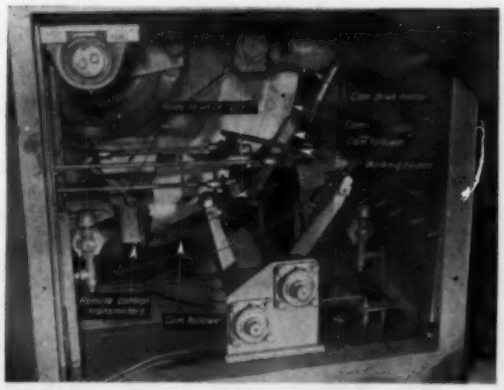
THE CIRCUIT incorporates speed control by tapered lands on the valve spools. Thus speed of the jib or ram arms is dependent upon the distance it is required to move. As the arm approaches the required position, it slows down and stops. Full speed movement of both arms requires 32 gpm at 325 psi—19 gpm for the jib and 13 gpm for the ram rotary actuator.

POSITION CONTROL

follow-up valve actuation



ARRANGEMENT FOR VALVE ACTUATION illustrates principle of walking beam. As cam follower arm approaches and momentarily follows a portion of the cam contour at a constant cam radius, cam end of beam moves to point B2 with transmitter end acting as pivot at point A2. This allows center beam to move to point C2 and displaces valve spool. As rotary actuator moves its arm to cam-signaled position, it actuates remote control receiver and mating transmitter to move beam to point A4 using point B2 as a pivot. Center of the beam moves to point C0.



ONE WALKING BEAM SERVES each valve for control of each rotary actuator. Near-ends of walking beams are positioned by cam followers acting through shafts. Far-ends of walking beams are positioned by remote control transmitters. Centers of walking beams are connected through rods to the control valve spools. When the jib or ram arm has moved to the required position, the remote control transmitter has positioned the walking beam so that its mid-point is at neutral position and valve spool is centered.

POSITION CONTROL

The control system, with the exception of the rotary actuators and the receiver components of the remote control units, is centralized in one main control station which also houses a joystick assembly interconnected to the manual end of the control valves to permit manual control of the machine.

Hydraulic power for the machine is obtained from a variable-volume, pressure-compensated pump. The 55-gallon tank unit incorporates a combination of electric immersion heaters and recirculating type water cooler thermostatically controlled to maintain the oil temperature at 130 ± 5 degrees F. for best machine operation.

Preparation of the machine for automatic operation is accomplished by attaching special marking devices to the cam follower arms. Then, simultaneously, as the operator manually begins to direct the ram head over the predetermined ramming path by use of joystick control, the rotation of the memory cams is begun. As the manipulation of the joystick lever transmits motions to the control valves and to the walking beam mechanisms, each point of the ram path is recorded on the rotating control cams. When the ramming cycle is completed the cam rotating motor is shut off and the joystick is allowed to return to its center position, thereby stopping the movement of the machine and the rotation of the cams at the same time.

The pair of marked cams are removed from the machine, their recorded contours cut out, and then reassembled into the machine. Marking devices are replaced by rollers, which are held in contact with the cams by means of spring tension. The linkage from the joystick assembly to the manual side of the control valves is disconnected.

JOYSTICK can be connected to control valves for determining the proper pattern of ramming the flasks and for marking the cam blanks. Operator practices with machine until proper pattern is determined. With marking device installed in place of cam followers, cams are marked and then cut. Machine then repeats same pattern automatically, after disconnection of manual linkage to control valve.

Automatic operation is then obtained by starting the cam motor which rotates the cams transmitting motion to the automatic side of the control valve through the follower arm and walking beam linkages.

The two remote control unit systems provide a follow-up for the ram and jib arms. Each system consists of a transmitter and a receiver. The receivers sense the position of the arms and transmit this information hydraulically to the transmitters which actuate one end of each walking beam. Each remote control unit system is a single-

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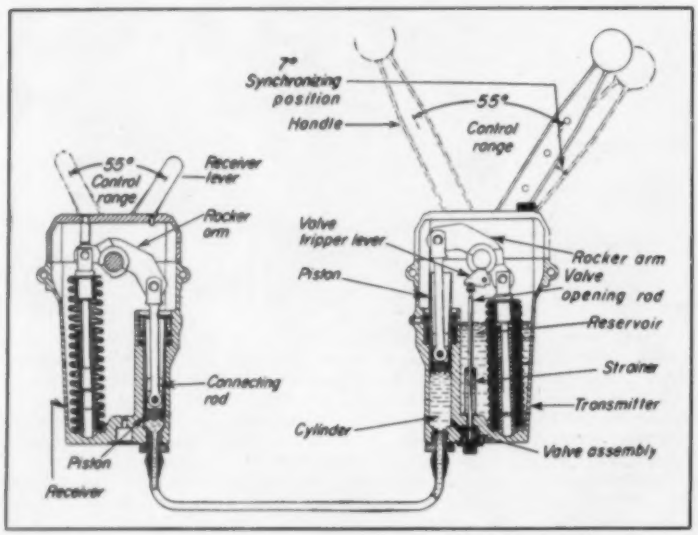

TRANSMITTER AND RECEIVER of remote control system form closed hydraulic circuit. Movement of transmitter arm to left pushes transmitter piston down raising receiver piston and rotating receiver arm in same direction. Transmitter spring is decompressed and receiver spring is compressed. Moving transmitter arm to extreme right position opens synchronizing valve to allow fluid flow to or from reservoir to cylinder.

APPLIED HYDRAULICS

COMPONENT DESIGN ARTICLE

CHECK VALVES

Check valves are used to pass flow freely in one direction and seal tightly against flow in the opposite direction. Here are several designs including the relatively new poppet type.

● By D. Van Deerlin

Chief Engineer, Circle Seal Products Co., Pasadena, California

CHECK valves can be divided into four main types:

- Ball
- Cone
- Poppet
- Swinging Disk

BALL TYPE

A ball type check valve usually contains a hardened steel ball, which is spring loaded and mates with a round seat of smaller diameter. These elements are enclosed in a suitable housing. The ball type check valve is most commonly used in hydraulic and pneumatic lines of relatively small diameter and is applicable to a wide range of line pressures. In those infrequent applications where a free ball is used, the mounting position of the check valve is important.

The ball check is relatively simple to manufacture and is low in cost but it tends to produce turbulence with resultant heating and pressure drop. Because of the ball's weight, it has a tendency to chatter, especially during

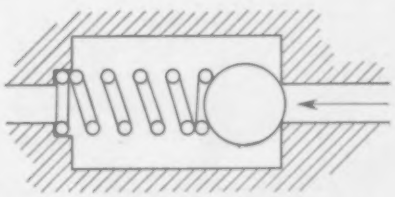

Fig. 1. Ball type check valve.

rapid flow reversal. The weight of the ball also makes this type impractical on air applications.

CONE TYPE

The cone type check valve is an outgrowth of the ball type. The ball is replaced by a sliding piston with a conical face on one end. This conical face seats against either a sharp-edge ring or conical surface. Because of the guided movement of the piston, this type of valve can be designed with better flow characteristics than the ball type. It is very useful for high pressure applications. The cone type valve has less tendency to hammer than the ball type

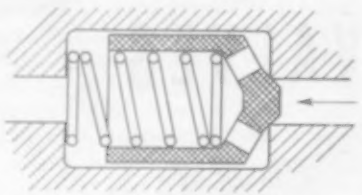

Fig. 2. Cone type check valve.

valve and has better flow characteristics. This type of check valve is susceptible to dirt and other foreign matter and may begin to leak after a length of service.

POPPET TYPE

A poppet type check valve consists of a mushroom shaped poppet with its stem guided in a sleeve. The head of the poppet rests on a flat, circular plane or against a tapered seat. The poppet head is usually spring loaded except where gravity on the poppet can be used satisfactorily or where the motion of the fluid can give satisfactory closure. Where ambient and working temperatures permit, a wide variety of materials can be used in poppet type check valves including stainless steel, bronze, brass, cast iron, plastic, and other synthetic compounds. The poppet type valve has good flow characteristics with little turbulence. It can be designed with very little chatter or hammer by using damping cham-

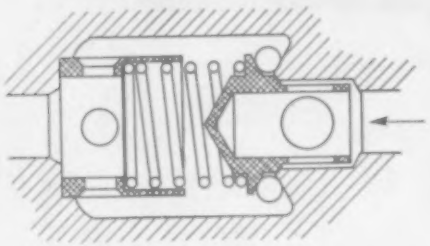

Fig. 3. Poppet type check valve.

bers. The poppet valve may be somewhat larger than the ball or cone types and may have a higher cost.

SWING TYPE

Swing check valves have one important advantage for some circuits—a low pressure drop. The valve consists of a hinged disk seating against a flat or tapered seat. The hinged disk is acted upon by the force of the moving fluid which easily lifts it from its seat allowing practically unrestricted passage of the fluid without any substantial pressure drop a-

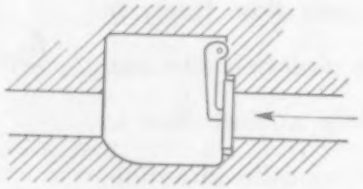

Fig. 4. Swing type check valve.

cross the valve. Mounting position of a swing check valve is important because of the action of gravity,

CHECK VALVE TYPE	ADVANTAGES	DISADVANTAGES
BALL	Low initial cost. Inherent simplicity.	Poor flow characteristics. Strong tendency to chatter. Tendency to hammer during rapid flow reversal.
CONE	Can be used for high pressure. Little tendency to chatter. Good flow characteristics.	May leak after some service. Susceptible to dirt or other foreign matter.
POPPET	Good flow characteristics. Little chatter and hammer.	Larger size.
SWING	Very good flow characteristics. Best suited for larger sizes.	Very susceptible to hammering. Limited mounting positions.

and this restricts its use considerably. Because of the light force required to open the valve, it is undesirable to use swing checks on applications where hammer, chatter, or high shock loading is likely to occur, or where absolute shut-off is required. Because of the mechanical arrangement of a hinged disk, this type is restricted to larger size valves.

SOFT SEAT DESIGN

A recent development in check valve design has been the soft seat type. In this design, an O-ring or other resilient seal is installed between the fixed and moving elements of the valve. This arrangement has the dual advantage of providing a resilient cushion against closing shocks and a seal for better control of reverse leakage. Any of the four types of valves can be adapted to use of a soft seat. The type illustrated in Figure 3 is basically a poppet type utilizing an O-ring as a floating seal between the conical metal seats. The introduction in recent years of soft seat type valves which are completely tight has simplified many circuits and allowed greater freedom in circuit design.

APPLICATIONS

An interesting example of the use of non-leaking check valves to simplify a circuit is illustrated in Figure 5. The system is used by an aircraft plant to test a high-pressure unit which contains a diaphragm. The body of the unit is subjected to 3000-psi pressure and the diaphragm to 50-psi pressure. In the 50-psi test, the check valve confines the pressure to one side of the diaphragm to determine leakage through the diaphragm. Any leakage through the check valve would make the test ineffective. In the 3000-psi test, the check valve allows pressure to be applied to both sides of the diaphragm. A shut-off valve could be used in place of the check valve, but if an operator failed to open the valve before starting the 3000-psi test, the diaphragm would be ruptured.

A typical application of a check valve is in a system incorporating an unloading valve and an accumulator which provides a high pressure reservoir, so that the pump does not have to run continuously. When the accumulator is up to full pressure, the unloading valve bypasses the pump discharge back to the reservoir and a check valve maintains the pressure in the accumulator. When the pressure in the system drops, the unloading valve closes so that the pump delivers to the system. If the check valve leaks, particularly in a system maintaining static pressure, the unloading valve will operate frequently putting an extra load on the pump.

Soft seat valves have been applied to air-hydraulic boosters which consist of an air cylinder reciprocating at low pressure and actuating a hydraulic cylinder at high pressure. Check valves are used on the suction and discharge lines of both cylinders of the double-acting unit. By using non-leaking check valves, the boosters can be used for such critical jobs as clamping, high-pressure testing, or where any leakage would cause a drop in pressure and frequent starting and stopping of the pumping unit.

An application where a leak-proof check valve is

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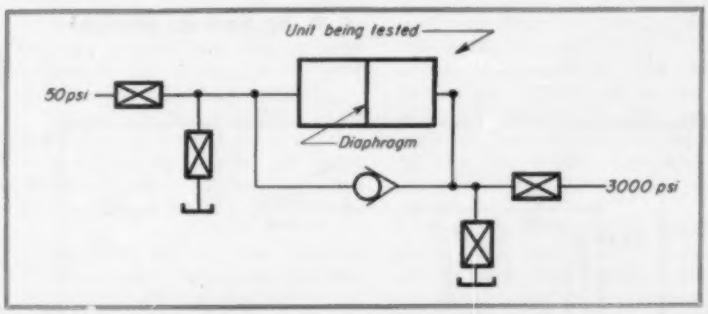

Fig. 5. TEST CIRCUIT for applying 50-psi and 3000-psi to an aircraft component.

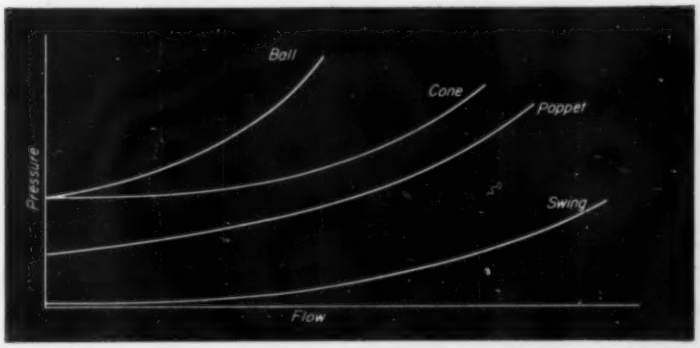

Fig. 6. TYPICAL CURVES for pressure drop across check valves.

Selection of pumps and accumulators for use in an electro-hydraulic servomechanism is in many ways similar to the procedures used for a general industrial application. The problem in both instances is one of determining peak loads and their duration as well as steady or continuing demands on pump capacity. In a servo system, there are certain factors to be considered in the capacity analysis which are not present in an industrial application. This article discusses some of the factors and calculations to be performed . . .

DETERMINING PUMP AND ACCUMULATOR SIZE

. . . for electro-hydraulic servomechanisms

• By Paul E. Straight

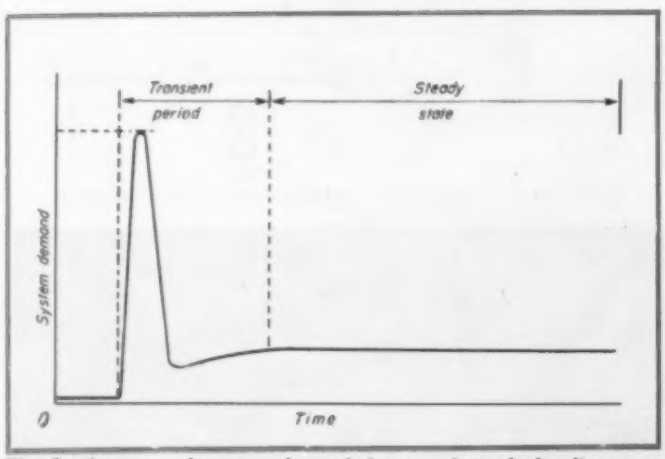

Fig. 1—A curve of system demand for an electro-hydraulic servomechanism shows a definite high-flow transient period during which flow demand is approximately five times that of the steady-state period. Such a flow requirement definitely makes the use of an accumulator economically sound.

DETERMINATION of the correct size pump and accumulator for use in a circuit is primarily a matter of determining what the flow demands are during the operating cycle. This analysis of flow demand is also the starting point for a determination of whether or not an accumulator should be used in a circuit. Such an analysis should usually be started by compiling a check list of the various factors influencing flow requirements.

A curve of system demand for an electro-hydraulic servomechanism, Figure 1, shows a definite high-flow transient period during which flow demand is approximately five times that of the steady-state period. Such a flow

PAUL E. STRAIGHT, *Electronics Engineer, Hagan Chemicals and Controls Inc., Pittsburgh, Pa.*

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Because of the parallel circuit built into these valves, simultaneous operation of two or more cylinders makes digging and load discharge one smooth continuous operation.

Consisting of an inlet section, five working sections and the outlet section, this tandem valve controls the operation of the cylinders which actuate the boom, swing, lift, crowd and bucket. The built-in combination safety relief-pressure control gives safety protection to the entire hydraulic circuit and prevents overloading the structural members of the equipment. The design of these new valves makes it a simple matter to incorporate special feature valves to give plus values to the equipment.

"Henry" mounts directly below this valve a swing cushion valve which smooths out the action of the boom as it comes to the end of its swing. This takes the shakes out of the equipment and reduces its wear and tear, thus lengthening service life of the equipment.

Service problems and breakdowns are minimized because the sectional feature of the tandem valve permits servicing in the field of any one section and does not require replacement of the entire valve.

Henry Manufacturing Company says, "We feel that Commercial valves have contributed to the dependability and performance which has accounted for many sales of our equipment when demonstrated against competitive machines."

You, too, will find that these new "Performance Rated" valves will improve your equipment's salability. Write to Dept. A-14, The Commercial Shearing and Stamping Company, Youngstown, Ohio, for the Performance Data which will show you what goes on inside these valves.

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requirement definitely makes the use of an accumulator economically sound.

Factors influencing steady-state and transient performance in an electro-hydraulic servomechanism are:

1. Frequency response.
2. Maximum cylinder or motor speed.
3. Valve leakage.
4. Load requirements.
5. Load inertia.
6. Load torques.
7. Type and duration of program.
8. Signal noise.
9. Valve movement necessary to hold controlled variable at set point during steady-state conditions.
10. Time between high load periods.

It will be recognized that many of these factors are present in any hydraulic system. In an electro-hydraulic servo, accuracy, load requirements, programming, signal noise, and steady-state valve movements influence steady-state requirements. These factors, therefore, influence pump size.

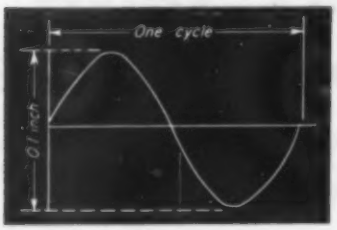
Frequency response, time to reach required output, speed of response, and programming may all affect transient performance. Thus, they may affect peak demand and, therefore, accumulator capacity.

System Analysis—In many instances, performance specifications of a hydraulic servo system may

EXAMPLES

To illustrate the application of the methods outlined, certain sample calculations will be performed.

Example 1: First the pump flow requirement for a maximum noise frequency of 2 cps and amplitude of ½ percent of piston stroke will be found. It is assumed that the hydraulic actuator is a cylinder 5 in. in diameter



with maximum stroke of 10 in. Total flow requirement is

$$Q = \frac{60ALF}{231}$$

or

$$Q = \frac{60 \times 19.6 \times 0.2 \times 2}{231} = 2.04 \text{ gpm}$$

where Q = flow, gpm; A = piston area, in.; L = total piston movement per cycle, in.; and f = noise frequency, cps.

Example 2: To determine pump capacity required for steady-state valve movement by the operator, continuous operation at 4 cycles per minute will be assumed. The same actuator as that of the previous example will be used. Then

$$Q = \frac{ALF}{231}$$

or

$$Q = \frac{19.6 \times 20 \times 4}{231} = 6.8$$

where Q = flow, gpm; A = piston area, sq. in.; L = total piston movement per cycle, in.; f = frequency, cycles per min. It is assumed that areas of either side of the piston are equal.

Example 3: Accumulator capacity for the transient condition will now be calculated. Assumed conditions are: maximum piston velocity = 10 in. per sec, pump capacity = 5 gpm, transient time = 5 sec, minimum working pressure = 1500 psi, maximum working pressure = 2000 psi, and accumulator charging pressure = 1000 psi. The actuator is the same 5 in. diameter by 10 in. stroke cylinder used in the previous examples.

First step is to calculate total flow requirement from

$$Q_t = \frac{60vA}{231}$$

$$Q = \frac{60 \times 10 \times 19.6}{231} = 51 \text{ gpm}$$

where A = piston area, sq in., and v = piston velocity, in. per sec. To find the flow required from the accumulator, pump capacity remaining after leakage is taken into consideration can be subtracted from the total flow requirement to find the flow which must be provided by the accumulator. In this case, leakage of 1 gpm is assumed, therefore,

$$Q_a = Q_t - 4 = 51 - 4 = 47 \text{ gpm}$$

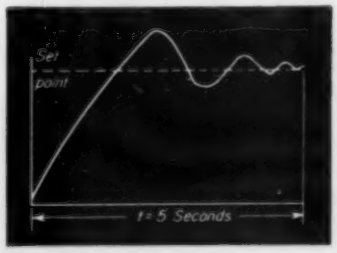
where Q_a = accumulator flow, gpm, and Q_t = total flow, gpm. Having determined flow rate from the accumulator, total volume of oil to be supplied by the accumulator can be calculated by multiplying rate by time, or

$$V = \frac{Qt}{60} = \frac{47 \times 5}{60} = 3.92 \text{ gal}$$

Actual accumulator volume is then determined from the relationships

$$P_1V_1 = P_2V_2 = P_3V_3$$
$$V_2 = V_3 + 3.92$$
$$V_3 = V_2 - 3.92$$

where V_1 = accumulator volume, V_2 = gas volume at P_2, V_3 = gas volume at P_3, P_1 = accumulator charging pressure, P_2 = minimum working pressure, and P_3 = maximum working pressure. Value of V_1 = 23.52 gallons. Addition of a safety factor of 15 percent would make this figure 27 gallons. Assuming that accumulators are available in multiples of 5 indicates that a 30 gallon accumulator should be used. However, there is one more factor to be considered. With accumulators of the commonly used bag type, there is a maximum flow rate which must not be exceeded to avoid clogging the discharge valve. This figure can be supplied by the accumulator manufacturer. This condition might make the use of a combination of smaller accumulators such as three 10 gallon accumulators necessary. Economics, or standard accumulator availability, might also dictate the use of such a combination.



not be known. Performance must then be approximated, based upon the known requirements of the overall control system.

As an example of this type of analysis, a blow-down wind tunnel pressure control system, Figure 2, will be considered. In this application, controlled pressure starts at zero, rapidly increases to the set value and then stays at this value within the specified accuracy, Figure 3. The control valve must perform in the same way to produce the required conditions. That is, the valve must open rapidly at the start of the run and quickly settle at the position determined by set point pressure. As the run progresses the valve must open gradually to maintain set point pressure as the pressure supplied by the accumulator decreases. For this analysis, it will be assumed that the positioner must operate at maximum velocity during transient.

During steady-state operation, two factors must be considered to determine pump capacity. One of these is the flow volume required because of noise and maximum amplitude. The other is the amount of oil required because the control valve is continuously moving toward the open position during steady-state operation. This requirement will be highest during short runs. Control valve velocity is then full stroke length divided by the minimum time for the run. Flow requirement would, therefore, be the product of piston area and velocity. This volume must be supplied by the pump.

Control programming can also affect pump capacity if program duration is long enough. Since the valve will be continuously moving during the program, oil must be supplied at a rate proportional to the slope of the programming curve. If program duration is short, this oil can be supplied by the accumulator. If program duration equals the control period, the pump will have to supply this oil.

Calculation Procedure—A simplified procedure for determining pump capacity is:

1. Calculate system leakage.
   a. Reducing valve, relief valve, etc. leakage.
   b. Pilot valve leakage.
2. Calculate signal noise oil requirement.
3. Calculate oil required for steady-state valve movement.
4. Calculate oil required for program schedule.
5. Sum individual requirements to obtain total.

Pump capacity obtained by following the outlined procedure will probably fall between two available sizes. The larger size should be used.

To select the proper size accumulator, the following procedure should be employed.

1. Find the time required for the transient, i.e., the time required to return to the steady-state flow requirement.
2. Calculate flow required to move the valve at saturated velocity over this time interval. In the general case this would mean multiplying maximum required flow rate by transient time.

Total volume obtained in Step 2 will in most cases exceed the actual requirement, but by using this method, calculation is simplified and an adequate safety margin is assured. ▼▼▼

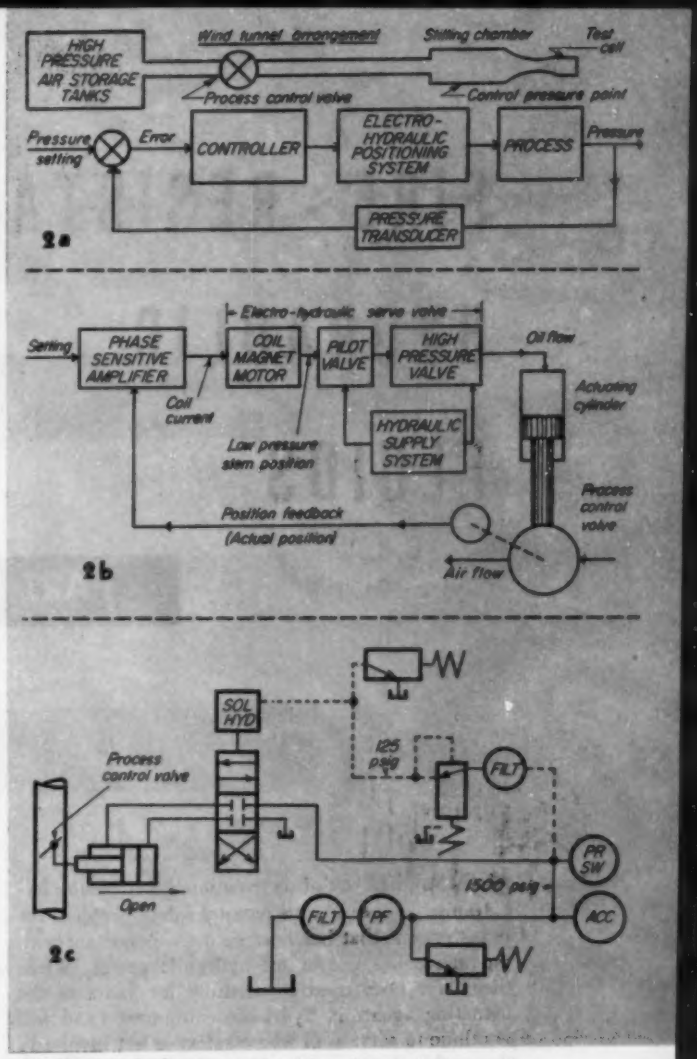
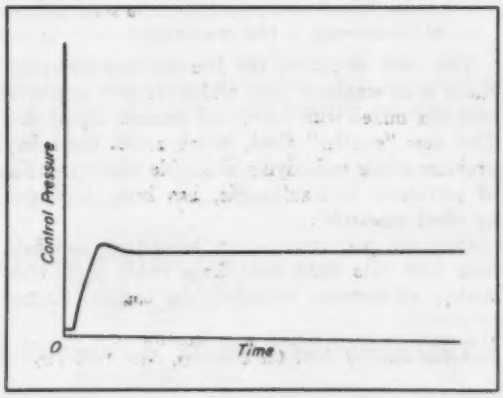


Fig 2—Block diagrams of a blow down wind tunnel pressure control system, *a*, and the electro-hydraulic servomechanism for positioning the control valve, *b*. A circuit diagram of the hydraulic system is shown at *c*.

Fig. 3—Characteristics of the variable to be controlled such as this curve of pressure in the blow down wind tunnel are valuable in determining what the operating characteristics of the control circuit must be.



FIRE - RESISTANT HYDRAULIC FLUIDS

PART I — Emulsion Types

• By A. S. Morrow,
H. E. Sipple, R. T. Holmes

FLAMMABILITY of conventional petroleum hydraulic oils has always posed a safety problem for industry, one that has become more important with the increasing use of oil hydraulic power. While they have been used successfully for years as the actuating agents in hydraulic equipment (and will continue to serve well where safety is not involved) flammable fluids are a serious fire hazard in those operations where ignition of the fluid could result from possible leakage or line ruptures.

During the past ten years, several fire-resistant fluids have been introduced that can be classified in two main groups:

> a. Pure synthetics having properties of fire resistance, wear protection and high bulk modulus.
> b. Mixtures of water and water-soluble synthetics, i.e. "snuffer" type fluids, whereby fire resistance results through release of a protective steam blanket in the presence of nigh temperature.

The most recent of the fire-resistant hydraulic fluids is an emulsion type, which consists of petroleum oils mixed with water and emulsifying agents. This new "snuffer" fluid, which solves the safety problem while embodying desirable characteristics of petroleum hydraulic oils, has been developed by Shell research*.

Over the past three years, laboratory and field tests with this fluid have been made in a wide variety of systems, including die casters, electric welders and decoilers. Over 44,000 system hours' operation have been logged with over 6,000 hours to date on two individual units. Satisfactory operation is reported in systems operated by vane and gear pumps up to 1,000 psi, and 2,000 psi for piston pumps. In these tests, the fluid has demonstrated these features:

> Excellent fire resistance, acceptable lubricating properties, emulsion stability to water separation, corrosion resistance, hydraulic efficiency, high viscosity index, film strength, good system cooling, oxidation stability, equipment compatibility . . . and economy.

The last advantage is by no means least for the fluid costs up to one-third less than conventional fire-resistant fluids, a major consideration not only in initial purchase price, but in reduction of expense for make-up loss.

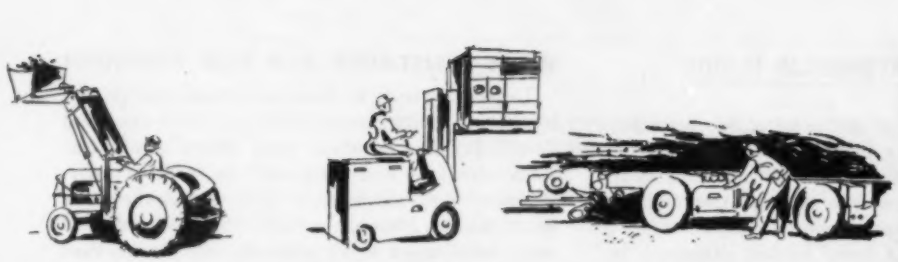
This fluid is recommended for hydraulic applications of 2,000 psi or less where there is fire hazard.

FIRE RESISTANCE

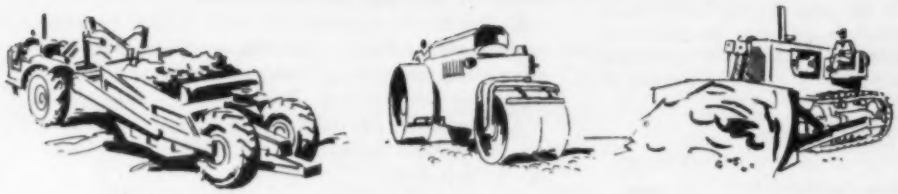
Irus Fluid 902 gains fire resistance though its relatively high water content, and will not explode or burn readily on contact with a source of ignition. When continuously exposed to a source of high temperature, the released steam blanket effectively reduces local temperatures and displaces oxygen from the immediate area. The fluids remaining

A. S. MORROW, H. E. SIPPLE, R. T. HOLMES
Technical Staff of Shell Oil Company, New York City

*Trade name, Irus Fluid 902



ENGINEERED HYDRAULIC CYLINDERS



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after the major portion of the water has been dissipated as steam may burn with an intermittent, luminous flame, but this flame will not trail away from the immediate source of high temperature, nor will the fluid support its own combustion.

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1. High Temperature (Pressure ignition spray test, Specification MIL-F-7100). The fluid is forced through a 0.0145-inch diameter sharp-edged orifice at a pressure of 1,000 psi and a temperature of 60 to 100 F. With an oxyacetylene torch adjusted to a neutral flame, an attempt is made to ignite the fluid stream at distances up to 18 inches from the orifice. Under these conditions, the fluid cannot be ignited.
2. Hot Manifold Test (Specification MIL-F-7100) A sand-blasted stainless steel tube is heated to 1300 F surface temperature with electrical resistance heaters. Ten milliliters of the test fluid are poured steadily on the tube in not less than 40 seconds nor more than 60 seconds. Under these conditions, the emulsion produces a few small flashes on the hot tube, but there is no continuous burning.
3. Pipe Cleaner Test (Modification of Specification MIL-F-7100) A 2-inch length of standard pipe cleaner is soaked in the test fluid, allowing the excess to drain off. The pipe cleaner is then passed repeatedly through a laboratory bunsen burner flame or between electrically-heated grids maintained at 1300 F. The number of passes before continuous burning occurs is considered a relative measure of fire resistance.

Typical results:

Irus Fluid 902	48 passes
Conventional petroleum hydraulic oil	5 passes

CONVENTIONAL HYDRAULIC fluids present a fire hazard when pressurized fluid comes in contact with molten metal, endangering personnel, equipment and the plant itself.

WEAR RESISTANCE AND FILM STRENGTH

Laboratory tests in commercial vane pumps, operating continuously at 1,000 psi, 1200 rpm, and 150 F fluid temperature, have shown equal wear rates with Irus and a conventional petroleum hydraulic oil. Cyclic tests in field units, where the pump suction lines are unrestricted, have indicated wear rates equal to or only slightly greater than petroleum oil.

Film strength, which is important in providing good antiwear and antiscuff protection for closely fitted machine parts, has been determined in a special high-speed spur gear test machine at 3600 rpm. Under the conditions of this practical wear-testing device, the emulsion-type fluid showed a measured improvement in antiscuff loading as compared with conventional mineral oil.

OTHER FEATURES

1. The high specific heat and heat transfer rates of Irus resulted in lower pump operating temperatures and reduced water flow at the oil coolers.
2. The fluid's distinctive yellow coloring enable leaks and spills to be readily spotted and easily traced. This reduces the possibility of contamination and mixing.
3. There has been no evidence of rusting or corrosion in field and laboratory tests.
4. The fluid's compatability with normal system components indicated that the emulsion has no more effect on packing materials, seals, and hoses than does conventional petroleum oil.
5. Representative paints used in and near hydraulic systems have indicated no unusual effect due to this fluid.

VISCOSITY

In areas of a system where the fluid would be under a relatively low rate of shear, i.e., suction screens and lines, the fluid is above recommended viscosities for some pumps. Enlarging these areas will permit satisfactory fluid flow and reduce the hazard of cavitation. However, in the pumps and valving, where the fluid is sheared, the viscosity is within designed limits of most equipment, and excellent performance is realized without any system modifications. Favorable viscosity-temperature relationship indicates maximum hydraulic efficiency and minimum difficulty in operating over a wide range of temperatures.

PREPARATION OF HYDRAULIC SYSTEMS

System preparation for use of Irus 902 consists primarily of cleaning. Although the fluid is completely compatible with conventional petroleum hydraulic oils, mixing with these materials will reduce the fluid's fire resistance and cause possible contamination.

CLEANING PROCEDURES

The preceding fluid in the machine should be drained completely, blowing down lines and accum-

OPERATIONAL CHARACTERISTICS AND PROPERTIES OF OIL EMULSION HYDRAULIC FLUIDS

TABLE 1—Typical Physical Properties of Irus Fluid 902

Specific gravity, 60/60	0.93
Weight, pounds per gallon	7.75
Color	Yellow
Neutralization No. (TBN-D)	2.5
TAN-C	0.18
Odor	Mild, pleasant
Toxicity	Compares to hydraulic oil
Specific Heat at 70 F	0.67 Btu
100 F	0.68
140 F	0.69
Coefficient of thermal expansion at 60 F	.0003
Minimum bulk fluid starting temperature (4000 SUS)	30 F

TABLE 2—Effect of Temperature upon Emulsion Viscosity for Irus Fluid 902 Containing 100 S.S.U. @ 100°F Oil. Viscosity index = 134.

TEMPERATURE, F	VISCOSITY, S.S.U.
40	2580
70	924
100	450
140	173
180	99.6

TABLE 3—Apparent Emulsion Viscosities by Modified ASTM D-1092-51

SHEAR RATE, SEC.-1 — 100 F	SHELL IRUS 902 EQUIVALENT VISCOSITY S.S.U.
0	450
250	263
600	252
1500	234

ulators, separating fittings at low spots and hand wiping sumps to assure a clean system. System cleanliness is necessary to assure maximum performance of close-fitting pumps, valves and pressure control devices.

a. New or clean systems should be carefully drained and a charge of premium hydraulic oil or Irus circulated during at least one working day to displace old oil from inaccessible parts of the system. Following draining of the unit, the system should then be filled with a second operating charge of Irus.

b. New systems containing rust-preventive compounds or oil, etc. These materials should be removed thoroughly from sumps and accessible points by hand wiping. The system should then be cleaned by circulating a turbine cleaner at the minimum operating pressure.

After all components have been operated to allow complete flushing, this cleaner should be carefully drained when the normal fluid operating temperature is reached. Follow this with a mineral oil flush and then displace any remaining oil with an Irus fluid flush. It is advisable to operate the unit during a normal working day on each of these flushing charges. An inspection of the sumps following each charge should be made. Finally fill the system with a complete charge of the new fluid.

c. Presently available synthetic and water-base fire-resistant fluids will affect the stability and performance of the emulsion-type fluid. Therefore, it is important that the synthetics be completely removed from the system. The synthetic fluid should be drained as completely as possible. The system should then be flushed completely with two mineral oil flushes, followed by a flush with Irus before the final charge. Operate the system during a normal day on each flushing charge, and carefully drain the system while the flushing material is still warm.

In addition, systems currently operating on synthetic fluid should be considered with respect to any modifications in special components, such as seals, hoses, paints, etc., which have been installed specifically for use with these fluids. During the flushing operations, and for a period thereafter, the suction screens and filters should be checked periodically to prevent build-up of deposits. Because of the fluid's cleansing action, there will be a tendency to remove and suspend sludges and deposits not completely removed during the cleaning.

It is recommended that light solvents or chemical cleaners not be used in connection with this fluid because of their effect on fluid stability, and possible reduction in fire resistance.

SUCTION SCREENS

Owing to an unusual characteristic of emulsion-type materials, this fluid appears to have two different viscosities. This phenomenon affects the use of the fluid only in requiring an increase in the capacity of the suction system.

Normally, hydraulic power systems are equipped with 100 mesh suction strainers having capacities (measured in terms of 225 SSU petroleum oil at 100 F) equal to about 1½ times the rated pump capacities. As a result of the higher low-shear viscosity of Irus, excessive pressure drop would occur across screens of this capacity with resultant pump cavitation and serious damage.

In all systems, it is absolutely necessary that suction line restrictions be reduced to allow adequate flow of the fluid to the pump under all operating conditions.

Typical recommendations by pump manufacturers are a maximum permissible vacuum at the pump inlet of 5 psi (10 inches of mercury) for vane-type pumps and 7.5 psi (15 inches of mercury) for gear-type pumps.

Tests have indicated that conversion to 50-60 mesh screens having more than 4 times the rated pump capacity will provide unrestricted flow. Providing the pressure side of the system with non-absorptive filters such as 200-300 mesh wire screens and edge-plate or knife-edge types will insure minimum solids contamination. Absorptive filters such as the clay, cotton, felt, paper or resin-impregnated types may remove certain fluid components that would adversely affect the product's stability and are definitely not recommended.

MAINTENANCE WITH "SNUFFER" TYPE FLUIDS

Continuous or periodic filtering of the hydraulic fluid is recommended to remove solids entering the system by various routes. Where different fluids are used in the same shop, the fluid on each machine should be positively identified through a marker on the fill pipe.

The fire-resistance of emulsion-type fluid is obtained through the inclusion of a large percentage of water which is held tightly in the fluid until it is exposed to higher temperatures. Thus, it is important that fluid temperature not exceed 150 F in order to hold to a minimum loss of water through evaporation.

It is advisable to take every precaution in using water-containing fluids in the proximity of molten magnesium.

Emulsion-type fluids will tend to separate a small amount of oil on the surface after long-term storage, particularly in a warm climate. This oil will readily remix when agitated and drums should be agitated before withdrawing small amounts for makeup purposes. Although the water will not normally separate from the fluid, water separation due to evaporation and condensation in an operating unit will be readily re-emulsified in the fluid by the dispersing action of the pump.

Here are a few hints on the application of emulsion type fluid:

1. **System should be thoroughly cleaned.**
2. **Contaminants should be continually removed from the fluid by use of the proper filters . . . such as metal screens or edge-type filters.**
3. **Maintain proper suction lines to prevent cavitation.**
4. **Operating temperatures should be 50 F to 150 F.**
5. **Do not exceed 1500-2000 psi pump pressure. The manufacturers' recommendations should be followed.**
6. **Agitate drums of the fluid thoroughly before drawing off any quantity.**
7. **If a system has been shut-down for prolonged periods, check fluid for separation, and if necessary, mechanically mix before starting pumps.**
8. **Periodically check for free water; loss or gain of water.**
9. **Occasionally check neutralization number if facilities are available.**
10. **Do not permit admixing of fire-resistant fluids.**

Emulsion instability or water separation may occur as a result of contamination of the fluid with certain chemical cleaners, solvents and synthetic hydraulic fluids, or after an extended period of severe usage. These conditions may be detected by placing a representative sample of the fluid in a clean 4 oz. bottle and allowing it to stand at room temperature. Separation of free water within a few hours is an indication of poor emulsion stability and the fluid should be replaced.

In comparison with premium hydraulic oils, wherein the neutralization number (Acid) TAN may rise during service, this material has a high neutralization number (Basic) TBN initially, and will gradually decrease in service. A minimum TBN value of 1.25 to 1.50 is recommended. ▼▼▼

This is the first of a series of basic articles on the different hydraulic fluids currently available for use in operations in or near hazardous areas. Subsequent articles will be:

Aqueous Base, Fire Resistant Fluids, by W. H. Millett, Carbide and Carbon Chemicals Co.

Phosphate Ester Base Fire Resistant Hydraulic Fluids, by F. H. Langenfeld, Monsanto Chemical Company.

Steps To Take When Installing Fire-Safe Hydraulic Fluids, by Charles R. Schmitt, E. F. Houghton Company.

Concluding article in this series will deal with the experience of a large die casting company.

Circle 107 →

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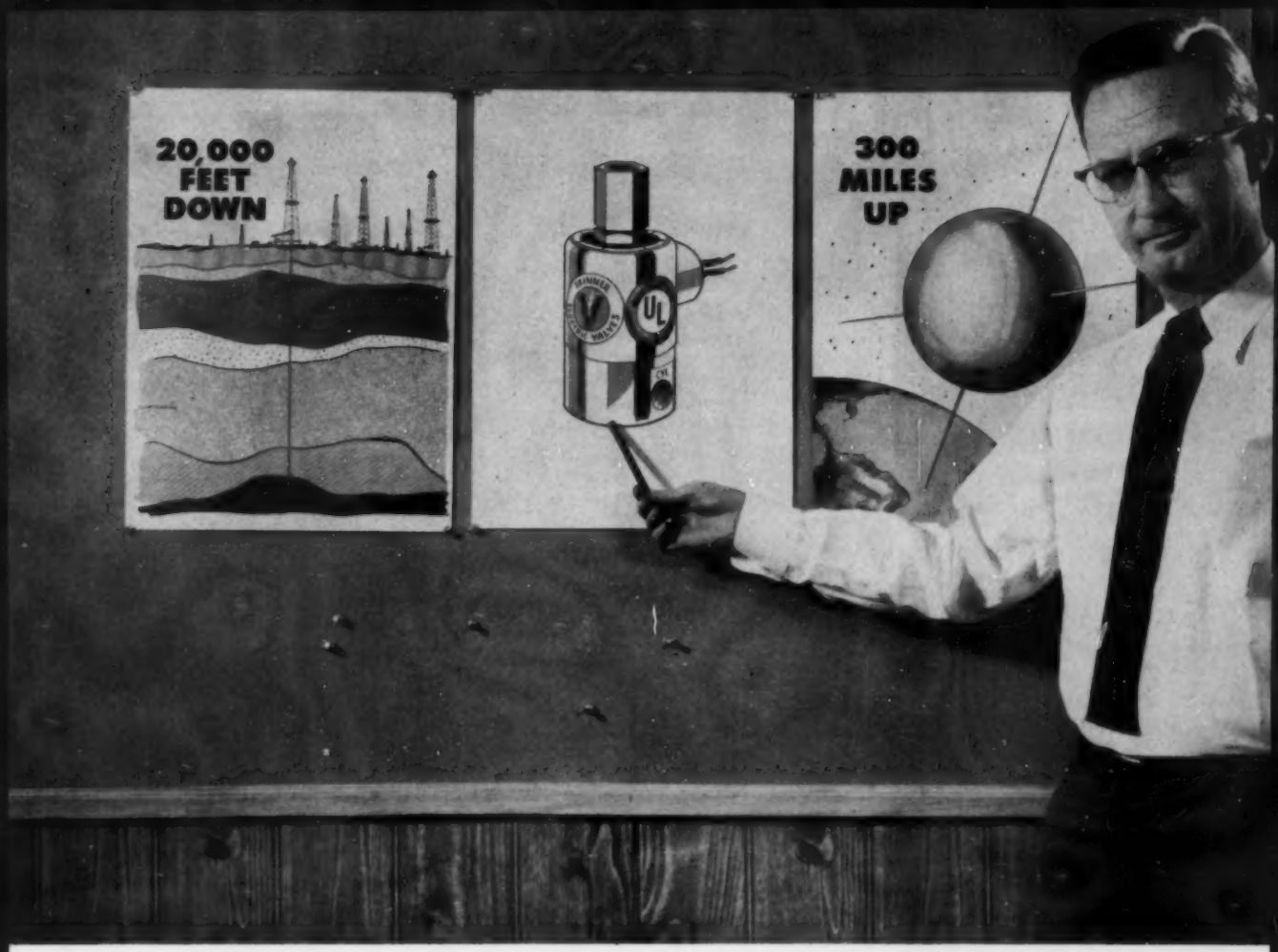

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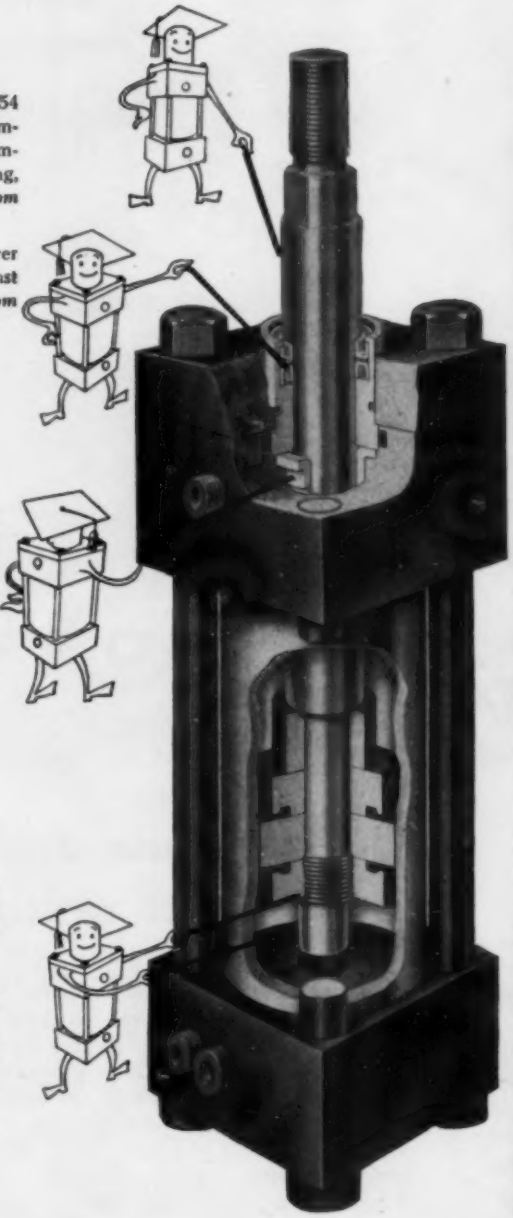

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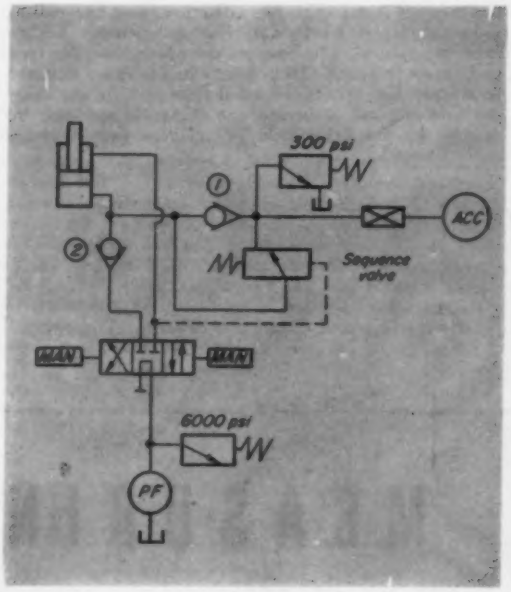
SIMPLE PREFILL SYSTEM



WHEN PUMP LOWERS CYLINDER, sequence valve is opened and fluid from blank end fills accumulator.

• By J. R. Fawcett

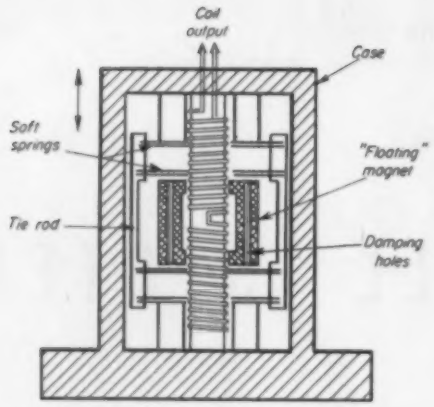
TO obtain a fast approach stroke, hydraulic presses are often equipped with two-capacity pumps, the high volume, low-pressure section being cut out automatically when the pressure begins to rise. However, in this design the approach speed is still limited by the size of pump it is economical to install, and the two capacity unit is necessarily expensive in comparison with a single, high pressure pump.

A faster approach stroke at less expense can be obtained by a simple, low pressure accumulator which is charged on the return stroke of the cylinder. The cylinder may be of the ordinary double-acting type or may be returned by kicker cylinders. The control valve is a 3-position type which unloads the pump and blocks the cylinder lines in the neutral position.

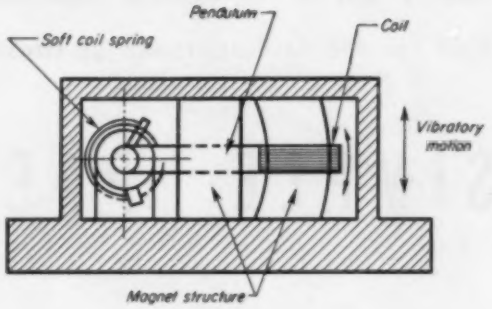
Because the accumulator pressure is limited to 300 psi, the accumulator can be a pressurized tank of comparatively light construction, and should have a capacity at least three times the cylinder displacement. There is no need to use a separator between the oil and the nitrogen, and it has been found in practice that recharging from a compressed nitrogen bottle about twice a year is all that is required.

Connecting the ram end of the cylinder to drain allows the pressure in the accumulator to force the cylinder up, the speed being limited only by the line sizes. The pressure decreases as the piston rises, but the inertia is sufficient to counteract the decrease of lifting force. When the ram meets a definite resistance, the pressure rises, and the pump takes over. Check valve 1 prevents leakage back to the accumulator.

When the control valve is shifted for the down-stroke, the pump pressure forces the cylinder down and check valve 2 diverts the oil from the bottom of the cylinder to the sequence valve which is opened by the rise of pressure in the return system. The displaced oil refills the accumulator until the pressure reaches the 300-psi relief valve setting, when the accumulator is fully recharged. The surplus then passes through the 300-psi relief valve back to the pump reservoir. The shut-off valve on the accumulator prevents leakage when the press is idle. ▼▼▼



TORSIOGRAPH—The basic principle of the standard torsiograph is the same as the linear pickup. In the torsiograph the output signal is generated by the relative motion of a magnet and a fixed coil. The magnet rides on two bearing supports, and is attached to the rotating shaft with a series of tangential soft springs. Thus it rotates at shaft speed, but is not subjected to the vibrations undertaken by the shaft. The coil which is fixed to the shaft does undergo the instantaneous variation in the shaft vibration process. The relative motion between the uniform rotational speed of the magnet and the coil will only be the shaft vibration. The signal from this pickup is a function of the angular velocity, and can be integrated with a resistance-condenser circuit to give a signal proportional to the angle of twist.



MOVING COIL PICKUP—In this type of pickup, the magnet is fixed to the structure, and the coil is mounted on a pendulum. For frequencies higher than the natural frequency of the pendulum, the free end floats in space. Thus it acts in the same manner as a mass. For this moving-coil type pickup, the magnet and its case structure are designed not only to supply the magnetic field but also to provide magnetic damping.

MEASURING

High speed, high output pumps can cause vibration which may limit the life of a machine. Here are designs for measuring this vibration, so that it can be analyzed and eliminated.

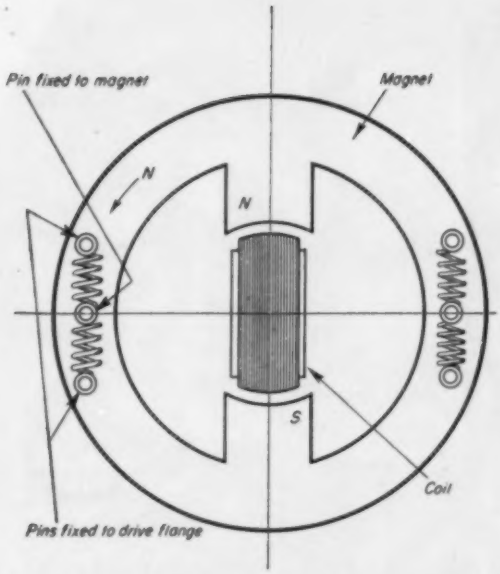
• By Harley L. Kressin

MACHINE designers learn by experience how to design parts to withstand a known load plus a forced vibration excitation, but very few designers have the time to analyze a system for resonant vibration. Instead they choose to avoid trouble by relying on rigidity as a preventive measure. However, weight, cost, or space may require that strength factors be held to a minimum, and vibrations that would otherwise be safe soon lead to failures in shafting, internal parts or outside case of a pump.

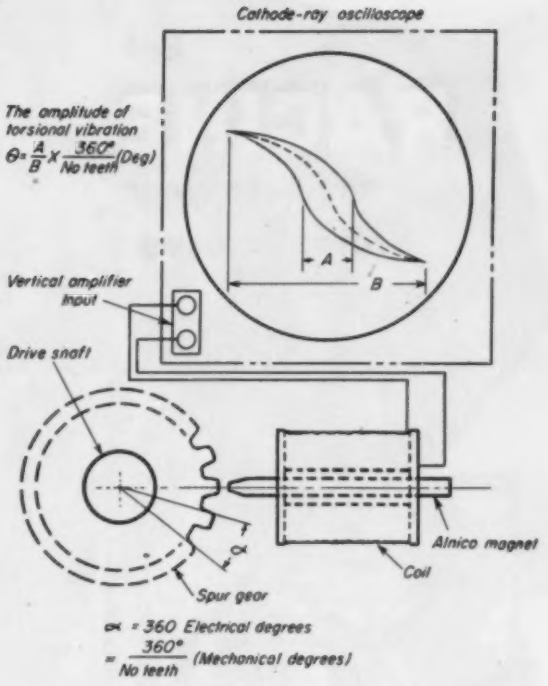
If a survey of linear or torsional vibration is conducted during the early stages of testing, the designer then has data he can use to correct his design. Factual data always help. Normally, the factual data needed are simply the amplitude and frequency of vibration throughout the normal operating range of the pump. The designer can then devise proper damping methods, or build correcting elements into his device to reduce the vibration amplitude to a small fraction of the original.

One basic instrument for linear vibration measurements is the sound level meter. This consists of an omni-directional microphone, a calibrated attenuator, amplifier, and indicator. A vibration pickup and integrating network can be substituted for the microphone.

Essentially, the microphone is a Rochelle-salt crystal device, which generates a voltage proportional to the acceleration of the vibrating body. The integrating network transforms the voltage output



FIXED COIL PICKUP—In the modern vibration pickup, as well as in the early types, the current is generated in a stationary coil of wire by a floating, hollow, cylinder-shaped permanent magnet. The motion of the magnet is restricted by viscous damping. In this pickup the coil is fixed to the case of the pickup so that it will follow the vibratory motion. The magnet which acts as a mass will remain fixed in space for frequencies of motion greater than approximately twice the natural frequency of the spring and magnet system.



α = 360 Electrical degrees

$= \frac{360°}{\text{No teeth}}$ (Mechanical degrees)

GEAR TORSIOGRAPH—When it is necessary to measure only the amplitude of torsional vibration of the shaft connecting two bodies, a spur gear of forty or more teeth attached to the shaft system can be used as a torsional vibration generator. If a coil of a great number of turns of wire with a permanent magnet core is then mounted so that the tip of the magnet is near the outside diameter of the gear, each tooth of the gear will generate one complete voltage cycle. When there is torsional vibration, the voltage cycles generated by each passing tooth of the gear will have a different time sequence about the average value. These voltage cycles can be fed directly into a cathode-ray oscilloscope. By synchronizing the scope to give a 1-cycle trace, the voltage cycles of the gear will appear on the screen superimposed on one another. The ratio of the total horizontal length of one cycle to the horizontal spread of the pattern at the median line, multiplied by the length of each tooth in degrees is the amplitude of torsional vibration.

VIBRATION

of the pickup to a voltage proportional to velocity, or to displacement. The sensitivity of this instrument is such that a movement of 40 micro-inches is measurable. The instrument also permits connecting an oscilloscope to determine the wave shape of the vibrating body. The instrument is portable and designed for simple operation.

NON-ELECTRICAL INSTRUMENTS

The light-beam vibration indicator is very good in the field of hand-operated, non-electrical vibration indicators. It has an exceptionally good frequency range from 15 to 500 cycles and will indicate an amplitude of .001 inch with good accuracy. ▼▼▼

HARLEY L. KRESSIN *was associated with Franklin Institute, Philadelphia, Pa. when this article was written.*

The vibration pickup is as simple in theory as it is in construction. From basic electricity, for a coil of N turns the total flux linking the turns is $N\phi$, and this flux is proportional to the current. The voltage generated in the coil is a function of the rate of change of flux.

$$E = N\frac{d\phi}{dt}$$

$$= L\frac{dI}{dt}$$

where: N=Number of turns on the coil
L=Self-inductance of the coil.

Therefore the voltage output of the coil is proportional to the rate of change of current. From basic dynamics, velocity of motion is equal to rate of change of displacement. The voltage of a coil is therefore proportional to the velocity. This voltage can be converted to a displacement indication by a simple condenser-resistor circuit.

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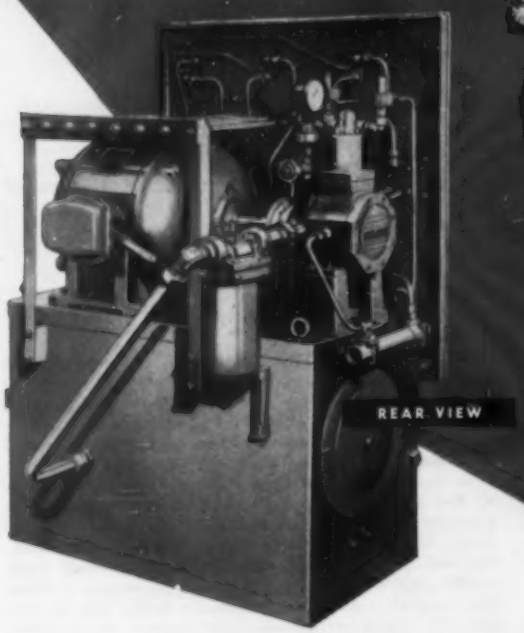

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HYDRAULICALLY OPERATED digger unit is mounted on a standard farm tractor. Vane pump is mounted on the center-line with the power take-off shaft.

HOW TO SELECT A FLUID POWER PACKAGE

. . . for mobile equipment

Use of a small vane pump with a planetary transmission proved more economical than a large pump with direct drive. The small unit has a lower original cost and a longer useful life.

• By Rodger Lovrenich

Generating fluid power from tractors, for hydraulic operation of mobile industrial equipment, poses a major problem in the earthmoving or materials handling fields. Application to the power digger is the most interesting because of the unusual method of obtaining fluid power from the tractor, and the reasons behind the selection of the method employed.

Basically, there are four ways of drawing hydraulic power from a tractor. These are shown in Table 1.

• **Methods**—The possibilities of powering a backhoe from a tractor fan belt, or a conventional tractor pump, are eliminated because the backhoe must have 15 fluid horsepower available for its operation.

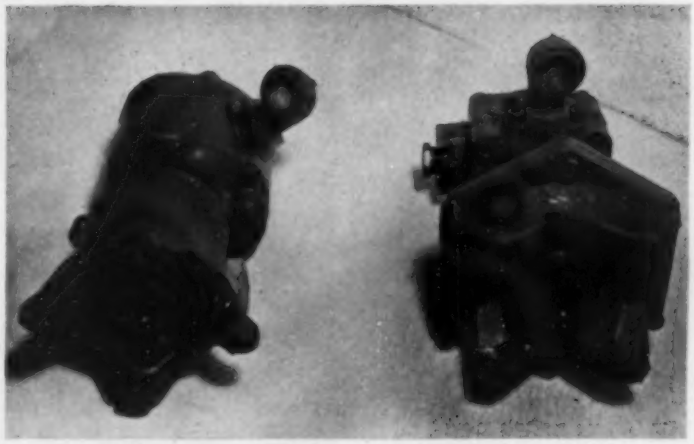
RODGER LOVRENICH, *Research Engineer, Sherman Products Inc., Royal Oak, Mich.*

This leaves the engine crankshaft and the tractor power take-off shaft as possible power sources. Since it is common practice to install a digger on a tractor in conjunction with a loader, the crankshaft method can be eliminated. Finally, since most loaders have a crankshaft-mounted pump, there would be no place to install a crankshaft-mounted digger pump.

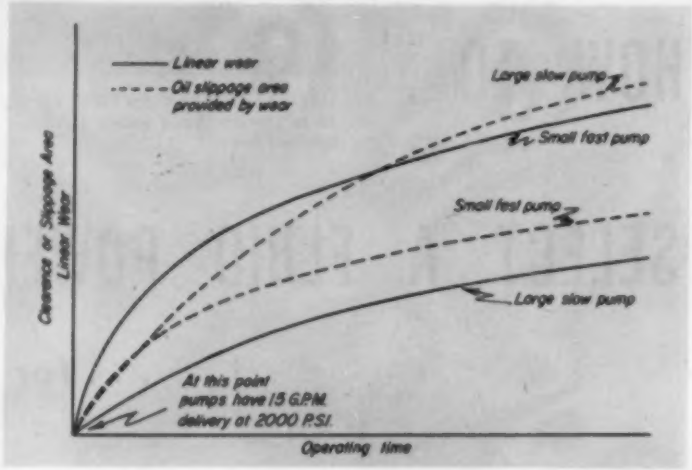
The idea of having the digger pump operate the loader, or vice versa, comes to a halt because it takes 8 gpm to operate a loader and 15 gpm to operate a digger. Using a 15 gpm pump to operate a loader would cause overheating and malfunctioning of the loader control valve, along with invalidating the warranty of the loader.

Thus the problem of obtaining fluid power for a hydraulic digger resolves into a project of obtaining oil at 15 gpm, at 1500 psi, from the power take-off shaft of a tractor which operates at 500 to 600 rpm under normal conditions.

Obtaining a hydraulic pump of adequate size to provide fluid power for a backhoe, when the pump shaft is driven at 600 rpm, is no particular problem, but from a cost standpoint the simple solution may not be the best. A smaller pump, which could be geared to the power take-off shaft to operate at a higher speed, might be a less expensive arrangement. Since all pumps used by Sherman are standard items, tooling costs and service problems are eliminated.



LARGE, SLOW-operating pump is shown at left with necessary parts. Small, fast-operating pump and transmission are on the right.


Linear wear
Oil slippage area provided by wear
Large slow pump
Small fast pump
Small fast pump
Large slow pump
Clearance or Slippage Area Linear Wear
At this point pumps have 15 G.P.M. delivery at 2000 P.S.I.
Operating time

SMALL PUMP operates three times as fast, but produces less oil slippage area due to wear. Curves are plotted on a logarithmic abscissa.

Tractors used are standard units, requiring an adaptor coupling to connect the pump shaft to the tractor shaft. An adaptor housing must also be provided to attach the pump housing to the tractor rear casting.

If a transmission could be designed with mountings attached directly to tractor and pump, no adaptor parts would be necessary, and its cost could help offset the cost of the transmission. In addition to money saved on adaptor parts, the smaller pump now needed for higher operating speed would cost less than the larger pump previously required.

• **Solution**—After careful consideration of gear cutting costs, bearing costs, and speeds involved, a step-up transmission with a 3.28:1 ratio was designed. The transmission was of the planetary type, requiring minimum space, and the pump could be mounted on the centerline with the power take-off shaft of the tractor. The gear ratio is small enough to keep maximum pump speed below 2400 rpm at maximum tractor engine speed, eliminating the possibility of over-speeding the pump.

• **Cost**—Table 2 gives cost comparison of each unit based on the price of a small vane type pump, which will deliver the required amount of oil when driven 3.28 times the power take-off speed. These figures indicate that a transmission and small vane pump cost 22 percent less than a direct driven large pump and its connecting compounds.

The pictures indicate the differences in size and appearance between the two units. After checking the cost figures, size and appearance of the pumps,

TABLE 1

METHOD	PUMP SPEED	POWER AVAILABLE
Tractor hydraulic system	½ engine (1100 rpm)	5 gpm at 2000 psi
Pump mounted on engine fan belt	(Depends on pulley size)	up to 5 hp
Pump mounted on front of crankshaft	Engine (2200 max.)	up to 40 hp
Pump mounted on power-take-off shaft	⅓ engine (700 max.)	up to 35 hp

TABLE 2

Cost Comparison

DIRECT DRIVE AND LARGE PUMP		TRANSMISSION AND SMALL PUMP	
Components	Units of cost	Components	Units of cost
Large pump	2.08	Small vane pump	1.00
Drive coupling	.16	Planetary transmission	1.08
Adaptor housing	.38	Attaching bolts,	
Attaching bolts, nuts	.05	nuts, washers	.02
Total	2.67	Total	2.10

the only other factor to consider is durability and performance.

• **Performance**—From a performance standpoint, both are equal, since both deliver the same amount of oil at the same pressure. Cavitation and starving in the suction line is more probable with the small pump, but with the oil reservoir two feet higher than the pump, and directly above it, no starvation has been experienced with either unit.

• **Durability**—When operating at different speeds the amount of wear experienced deviates from the expected. Both pumps tested were vane type, and no measure of wear on the cam ring or the vane ends was made. This was considered insignificant because as the vanes wear, they tend to slide out, still keeping contact with the cam ring. Records of vane pump failures previously experienced bear this out.

Records show that 90 percent of all vane pump failures on power diggers resulted from excessive clearance between the rotor sides of the vane and side plates of the rotor housing. Failures attributed to cam ring or vane end wear were less than 5 percent of the total. Also, pumps having cam ring failure had given long, trouble-free before failure occurred.

Therefore, the important factor in vane pump wear is the clearance between the rotor, vanes and side plates. It would seem that in running three times as fast, the pump would wear three times as fast, and produce three times as much clearance between rotor and side plate. However, experience indicates this is not true. As side clearance of the pump increases, it provides a loose running fit and wear is less than when the pump was new and tight.

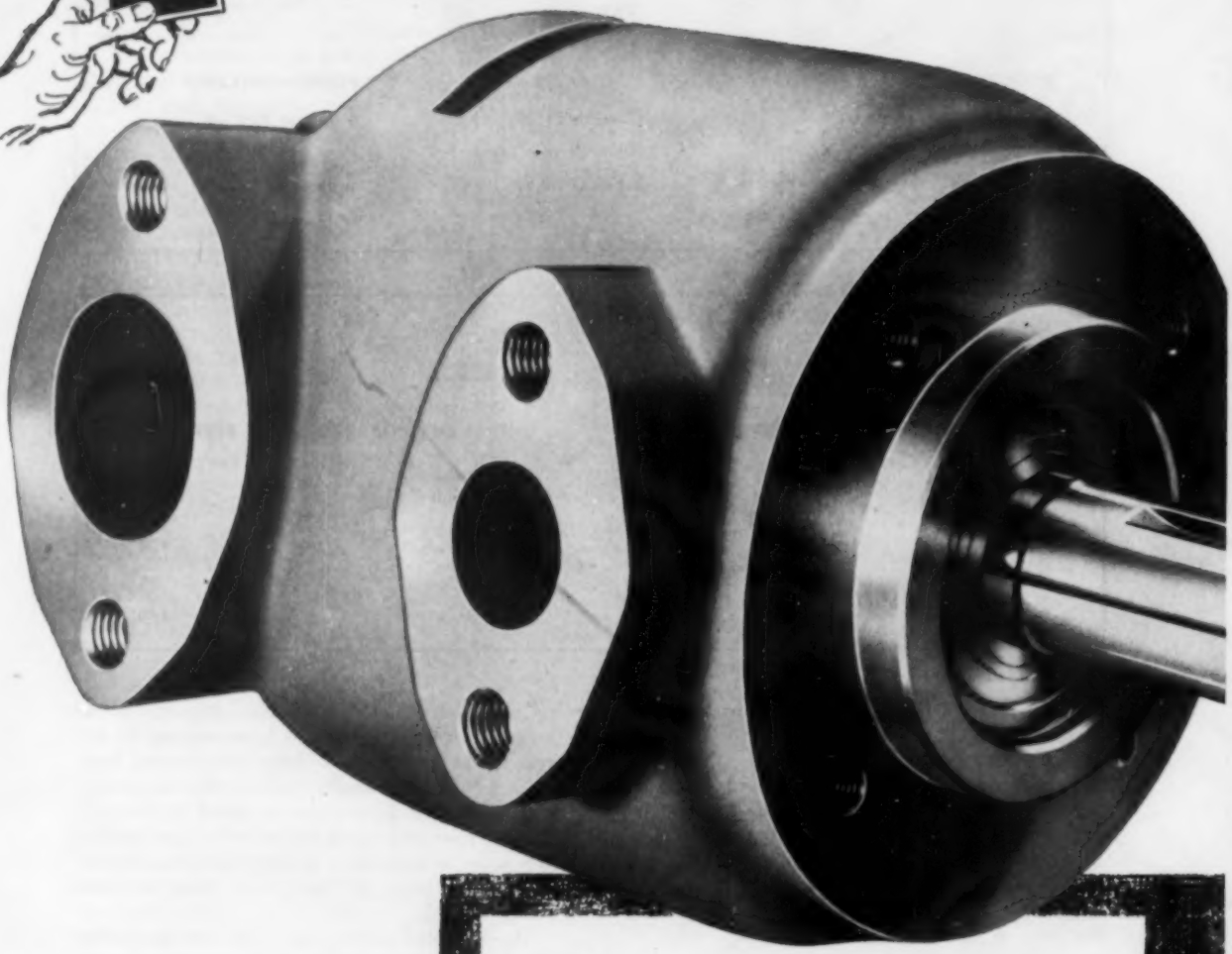
The graph shows wear experienced by two pumps, one operating at three times the speed of the other. The fast operating pump wears faster, but since the slow pump is three times as large, each unit of wear on the slow pump produces three times as much clearance area.

Also indicated on the graph is the average pattern of wear experienced with several pumps under different conditions. Some were used in exceptionally clean locations, while others were used in dirty locations. Pumps in dirty locations wore faster, but the general shape of wear curves was the same. These curves show general trend of wear with reference to use, and do not indicate actual hours of use to provide a definite wear, since this depends largely on the cleanliness of the system. The pumps used in these tests were symmetrical, radially-balanced, vane pumps with ground steel cam rings.

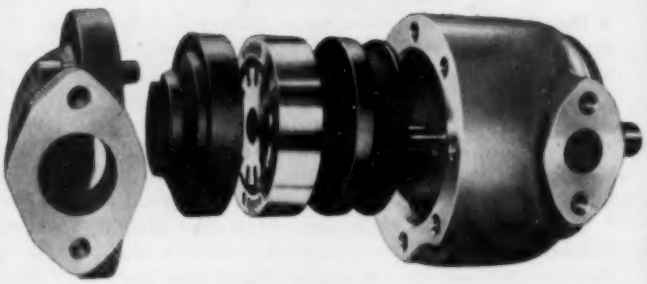
Although the slow, large pump wears less, this wear provides a greater clearance area for slippage in any given amount of time. Therefore, it is reasonable to believe that the small pump will outlast the large one, as far as satisfactory operation of a digger is concerned. Extensive field testing has proven the superior durability of the small fast pump.

This tendency of durability with regard to speed may be true only in the digger application, but the results obtained should be given consideration when durability of vane pumps is in question for any application. ▼▼▼

NEW FROM DENISON



For mobile equipment
For special machinery
For automation



Denison's exclusive cartridge construction. *Side plates hydraulically loaded to maintain uniform pressure on rotor regardless of delivery pressure.*

Continuous 2000 psi service in a versatile vane-type hydraulic pump

FOR MOBILE EQUIPMENT, less weight, increased payload

FOR SPECIAL MACHINERY, more power in less space

FOR AUTOMATION, heavy-duty design for low maintenance

● Here are the important features you can engineer into your designs with Denison's new "T" Series balanced vane hydraulic pump.

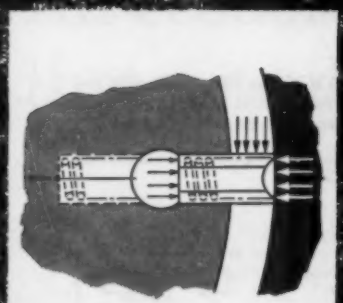
Long, efficient life because Denison's fully-balanced vanes and rotors reduce wear on cam rings and thrust plates to give long pump life with minimum maintenance.

Packs More Power in Less Space. Internal friction is lower, volumetric efficiency is higher. Actually packs 50 h. p. in less space than a conventional 3 h. p. electric motor where space and weight are a premium.

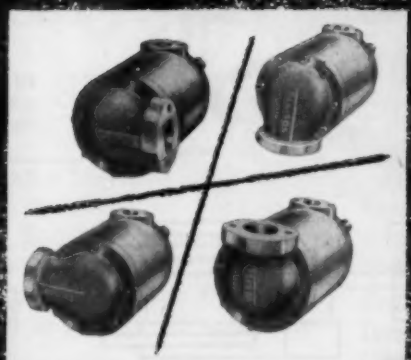
Cold-Weather Starting, under severe weather conditions, to maintain construction schedules.

Fast, Easy On-the-Job Service because the complete pumping cartridge can be removed and replaced as a unit without special tools or skills.

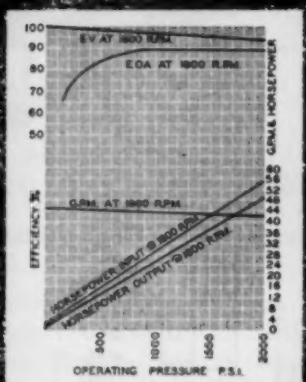
Write for complete engineering specifications in Bulletin 200. Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.



***Hydraulically balanced vane construction** cuts excessive wear on vane and cam ring . . . for longer life, higher volumetric efficiency.*



***Universal Mountings** . . . may be mounted in any of four different positions—face, flange or bracket mounted. Operates clockwise or counter-clockwise.*



Performance curve of "T Series" vane-type pump illustrates high volumetric efficiency.

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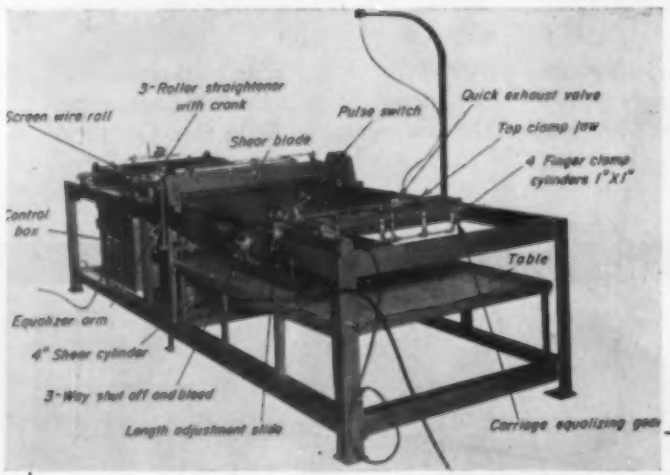
SPECIAL MACHINE CUTS SCREEN ... *using air powered motion*

Production was greatly increased by applying pneumatics to this job. Machine unrolls, straightens and cuts the wire 8 pieces per minute in any size to 60 inches long and 36 inches wide.

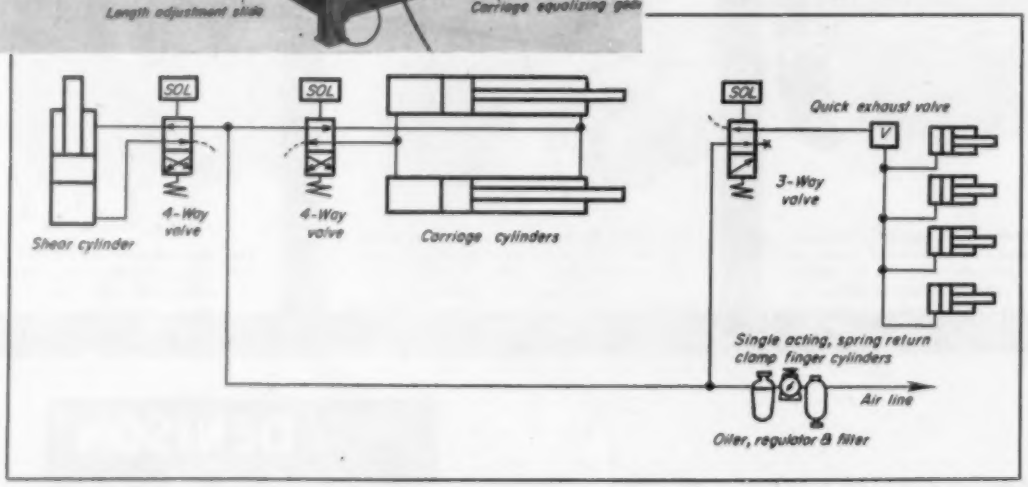
DESIGNED by Womack Machine Supply Company, Dallas, Texas, for screen wire cutting, this machine can handle any material which will not stretch too much or break.

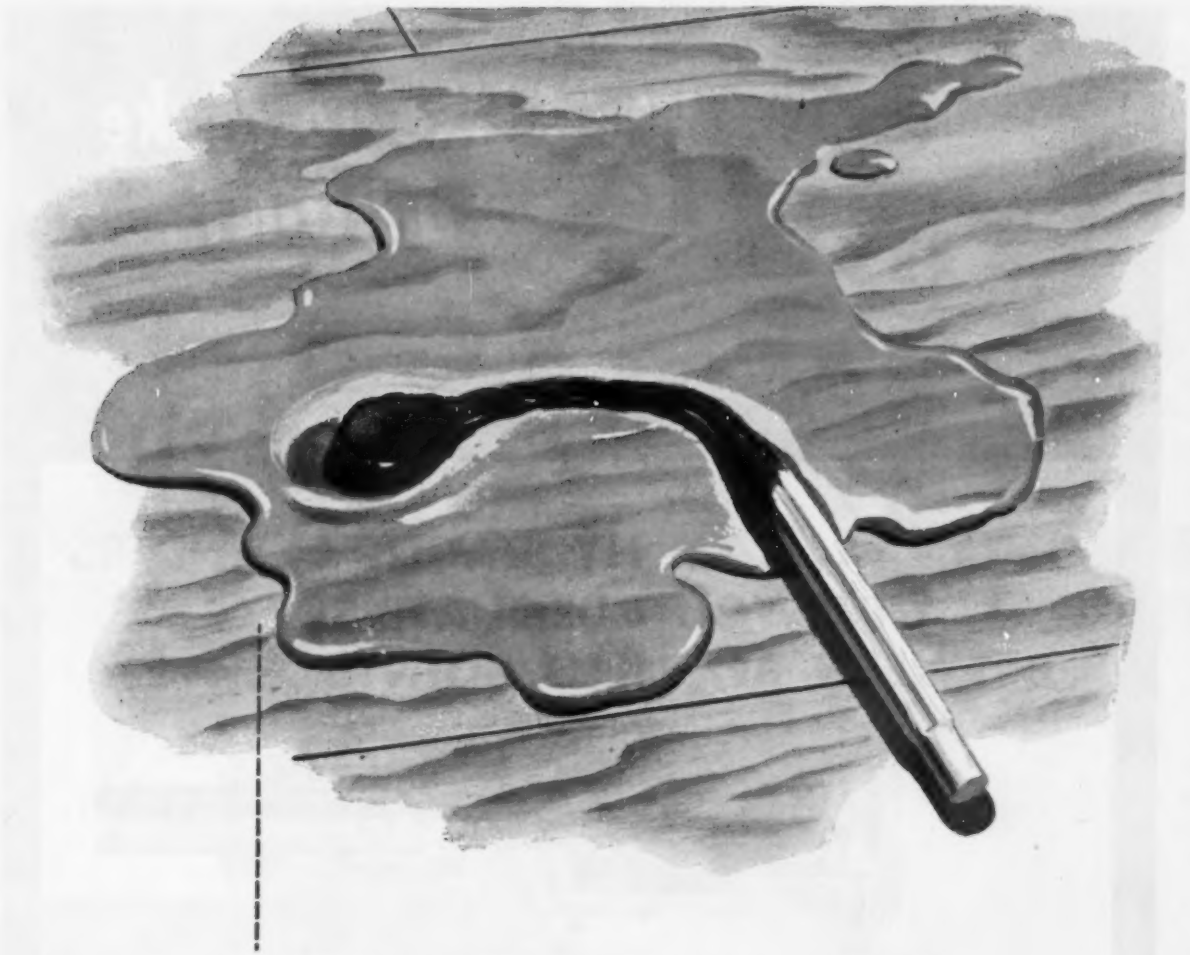
Carriage advance is cushioned by the cylinders as the fingers reach into the shear and close on the wire. When carriage moves back within 3 inches of an adjustable stop, it contacts an adjustable air cushion cylinder, and as it stops it operates the one-way impulse switch activating the shear. Completion of shear stroke trips a limit-switch to the 3-way valve, opening the fingers and dropping the screen on the table. ▼▼▼



MATERIAL pulling carriage is driven by two 2-inch bore air cylinders and equalized by rack and pinion assembly to insure square cutting.

DIAGRAM shows simple circuit required for shear, carriage and clamp finger cylinders.





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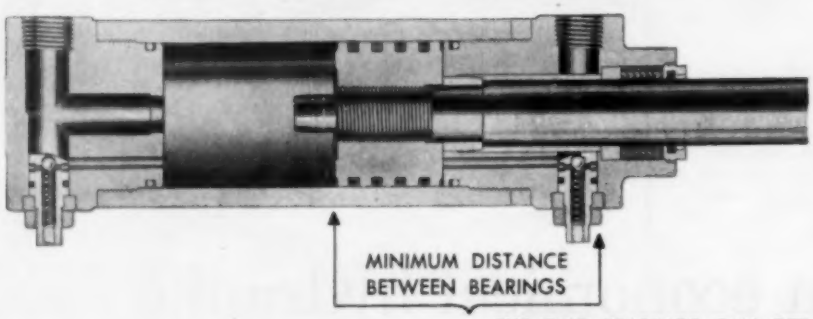

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2. Increased rod seal life
3. Reduced power eating friction
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Can you design an electrical circuit to control sequencing of three cylinders? Do you know when to use spring-centered or no-spring valves? Knowing how to apply relays is one of the most important parts of developing electrical control. Circuit applications in this article follow up last month's Part 1 which outlined characteristics and features of relays.

RELAYS and CONTACTORS

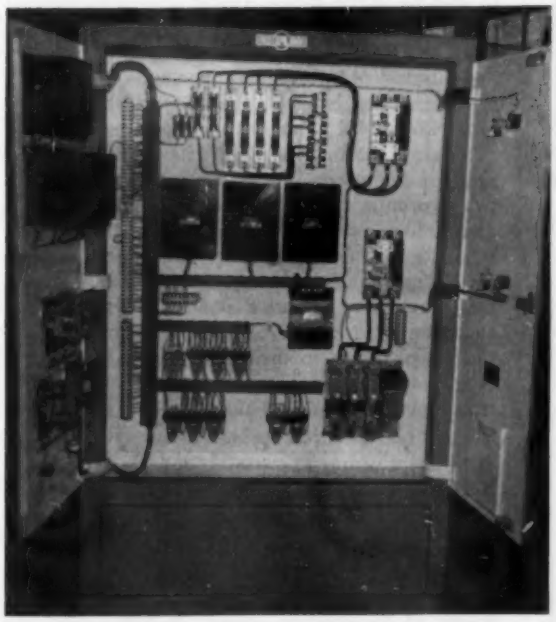


Fig. 1. THIS ELECTRICAL CONTROL PANEL for an injection molding machine illustrates good installation practice. Relays are installed below and to one side of higher voltage components. Space has been provided for additional relays.

PART 2

• By Kenneth B. Rexford

THE use of relays and contactors involves two fundamental considerations:

a. Transfer of information.

b. Transfer of power.

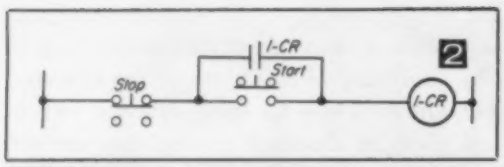
Normally relays are used for transfer of information and contactors for transfer of power.

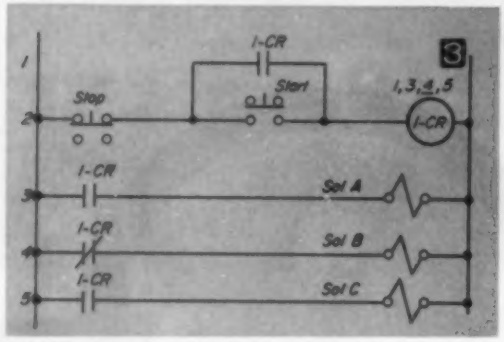
In designing electrical control circuits with relays, one of the first simple circuits to consider is the use of one relay with a start-stop pushbutton and interlock contact shown in Figure 2.

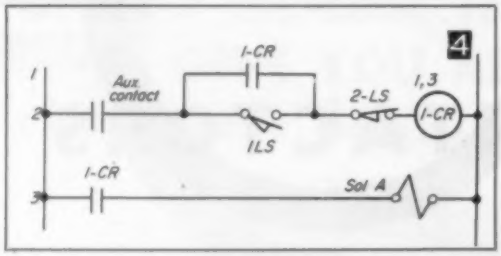
This circuit shows the typical symbols for a relay coil and normally-open contact. Both are designated as 1-CR. Additional information can be added by locating the contact as to its position on the relay.

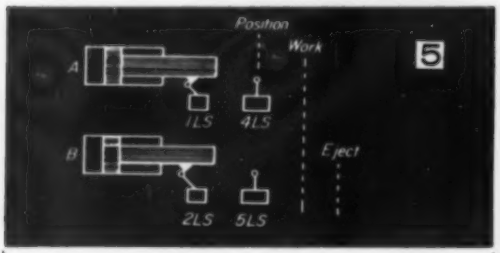
The circuit of Figure 3 has been developed from this basic circuit using three additional contacts to energize solenoids. In this circuit,

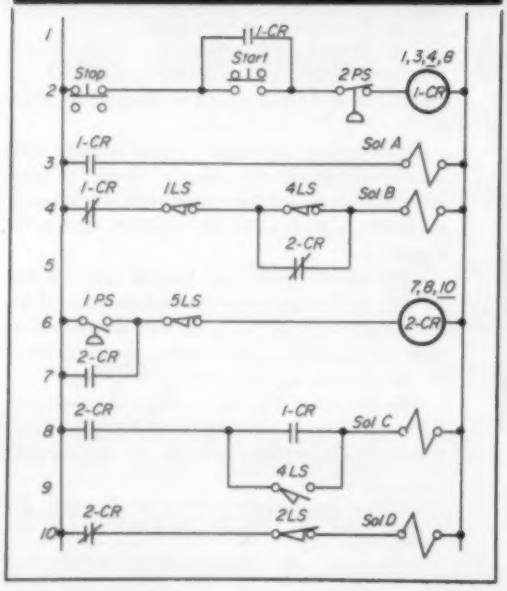
KENNETH B. REXFORD, *Chief Electrical Engineer, Hydraulic Press Mfg. Co., Div. of Koehring Co., Mt. Gilead, Ohio*











normally-open contact 1-CR closes to interlock around the start button as before. Additional normally-open contacts of relay 1-CR close to energize solenoids A and C and normally-closed contact 1-CR opens, de-energizing solenoid B.

The lines of the circuit are numbered at the left of the circuit. Above the relay coil is a key to aid in locating the contacts on that particular relay. In this circuit contacts of relay 1-CR are located in lines 1, 3, 4, and 5. The underscored number 4 indicates the contact is normally closed.

In determining how to use relays to control fluid power circuits, two questions must be answered:

a. Can the solenoid valve be energized directly from pushbuttons, timer contacts, or limit switches, or would it prolong the life of these components to handle the inrush current of the solenoids through relays?

b. Is additional information required at the time of the solenoid action that can be carried more conveniently by relay contacts?

Illustrating the requirement for additional information, a typical circuit used with an adjustable-position slow-down for ram travel is shown in Figure 4.

The circuit is initially energized by the closing of an auxiliary contact. It is required that solenoid A be energized between two ram positions as monitored by limit switches 1-LS and 2-LS. Furthermore these positions must be adjustable throughout the range of ram travel.

The use of only the limit switches and the solenoid would require an adjustable cam long enough to span the entire stroke. This is quite a mechanical problem particularly on long stroke rams. Using the relay, the first limit switch is momentarily actuated and interlocked by a relay contact and only a single, short cam need be used. The relay is later de-energized when 2-LS is momentarily actuated.

Figure 5 is another circuit illustrating this design consideration. This system involves control of two hydraulic rams. Ram A extends to the work and builds pressure. On a signal from the pressure switch, ram B extends to the work and builds pressure. When ram B has completed its forward stroke, ram A retracts to position at 4-LS and ram B then continues its forward stroke, ejecting the work. Both rams then return to their initial positions.

Solenoids A and B operate a valve which controls ram A. Solenoids D and C operate a valve controlling ram B. Pressure switches 1-PS and 2-PS monitor pressure on rams A and B respectively. Normally-closed limit switches 1-LS and 2-LS are held open when the rams are in their initial positions.

Limit switch 4-LS controls position of ram A for the ejection stroke of ram B, and 5-LS controls length of the ejection stroke. In this circuit the relays energize the solenoid valves as well as act as information carriers.

Mechanically latched or magnetically held relays serve a definite function in fluid power control. They can be used as memory devices because their

contacts remain in the actuated position, even though the main coil has been de-energized. Energizing an auxiliary coil or section of the main coil releases the contacts to their original position.

Figure 6 shows a layout and circuit where hydraulic rams A, B, and C function in the following cycle:

a. Ram B moves to position 2 and returns to position 1.
b. Rams A and C move to position 4 and 6 simultaneously.
c. Ram B moves to position 2 and returns to position 1.
d. Rams A and C move to positions 3 and 5 simultaneously.

At the beginning of the cycle the rams are in the positions shown and limit switches 2-LS, 3-LS, 5-LS, and 6-LS are actuated. Relay 3-CR is energized and solenoid A is energized maintaining rams A and C in the positions shown.

Relay contact 15-CR is closed by some auxiliary starting circuit and energizes relay 6-CR. This energizes solenoid B and ram B moves from position 1 to position 2 where pressure increases. Contacts of pressure switch 1-PS close energizing relay 1-CR. This de-energizes relay 6-CR and solenoid B. The spring-loaded solenoid valve directs fluid to retract ram B.

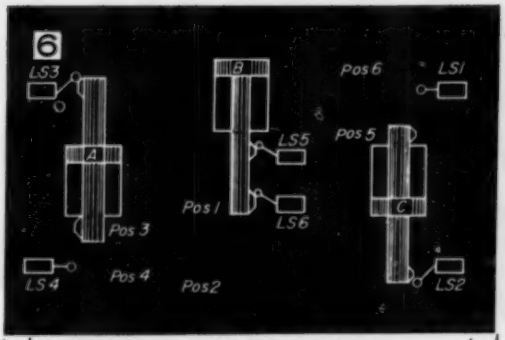
As ram B returns to position 1, it actuates 6-LS energizing the main coil of latching relay 5-CR. This de-energizes solenoid A. Ram A moves from position 3 to position 4, and ram C moves from position 5 to position 6.

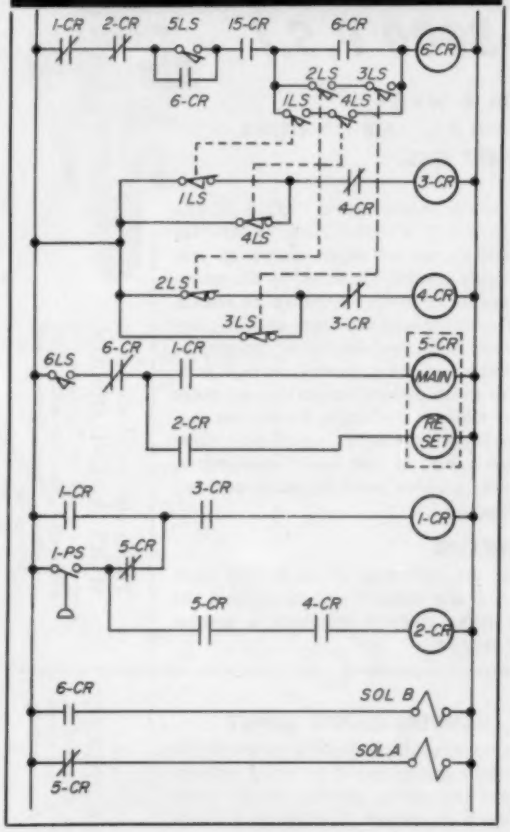
As rams A and C start to move, 2-LS and 3-LS are deactuated. As these rams reach positions 4 and 6, 1-LS and 4-LS are actuated. Relays 3-CR and 1-CR are de-energized and relay 4-CR is energized. The main coil of latching relay 5-CR is de-energized, but because it is a mechanically latched relay, it remains actuated.

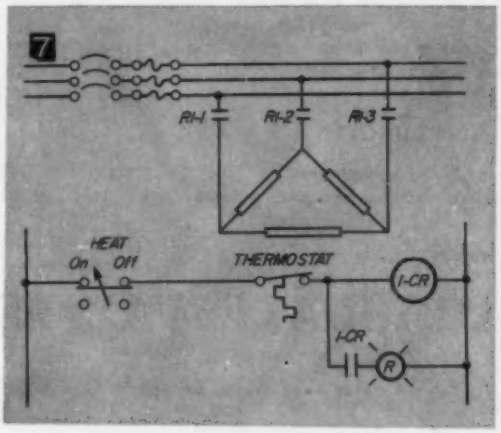
At the beginning of the next cycle, 1-LS, 4-LS, 5-LS, and 6-LS are actuated. Relay 4-CR is energized and auxiliary start contact 15-CR remains closed.

Again, relay 6-CR is energized. Ram B moves from position 1 to position 2 where pressure increases to close contacts of pressure switch 1-PS energizing relay 2-CR. Relay 6-CR is de-energized, as well as solenoid B.

As ram B returns to position 1, it actuates 6-LS energizing the reset coil of 5-CR. This deactuates the relay and energizes solenoid A moving ram A from position 4 to position 3 and ram C from position 6 to position 5. This completes the cycle.







CONTACTOR APPLICATION

In using contactors for the transfer of power, one of the more common uses is the oil immersion heater. Generally it is thermostatically controlled. A circuit showing this is shown in Figure 7. If possible the load should be arranged for a balanced 3-phase connection. This minimizes the conductor size and may decrease sizes of the contactor and

Continued on next page

STOP CYLINDER CREEP

WITH 'SHEAR-SEAL' SOLENOID VALVES

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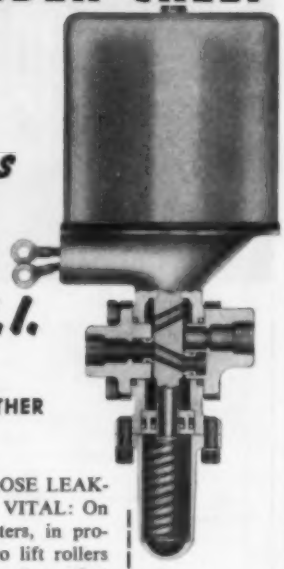

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because the movement of the sealing members does not depend on lubrication, the direct acting solenoid maintains a positive power margin.

This is why we don't use SPOOL VALVE DESIGN, they depend on leakage for lubrication, dirt can enter spool clearances, cause binding and coil burnout.

LONG, MAINTENANCE-FREE SERVICE

is assured through the lapping action of the Shear-Seals against the slide, which actually improves the sealing qualities of the valve with each operation. The small amount lapped from the Shear-Seals after millions of cycles is compensated by a back-up spring. Dirt or pipe scale cause no damage or failure because the spring keeps the sealing surfaces in constant intimate contact.

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RELAYS AND CONTACTORS

concluded from page 99

protection devices compared to a single-phase connection.

In some cases where the heaters are controlled by pyrometers, straight off-on control, or proportioning control, the rating of the contactor should be decreased by at least 40%, because rapid operation of contacts under normal rated load will shorten their life.

Two important points in the operation of relay or contactor contacts should be emphasized. Most relay contacts are covered with a thin coating of silver alloy. This gives a long life and eliminates overheating as in a copper-to-copper contact. A problem arises when some well-meaning electrician or maintenance worker uses a heavy abrasive or file to "dress" or "clean" contacts. This action destroys the silver coating and shortens the contact life.

A second problem involves the condition of the contact surfaces and the tension on the contacts in their normally-closed condition. Discoloration or slight pitting does not harm the contacts. However if they become heavily pitted or burned, they should be replaced. Often a cleaning solution such as carbon tetrachloride can be used to remove dirt or grease. Another method is to draw a strip of tough paper between the contacts using a fine abrasive such as jeweler's rouge.

Normally-closed contacts are difficult to check visually. Failures in the electrical control system can frequently be traced to malfunctioning normally-closed contacts.

INSTALLATION

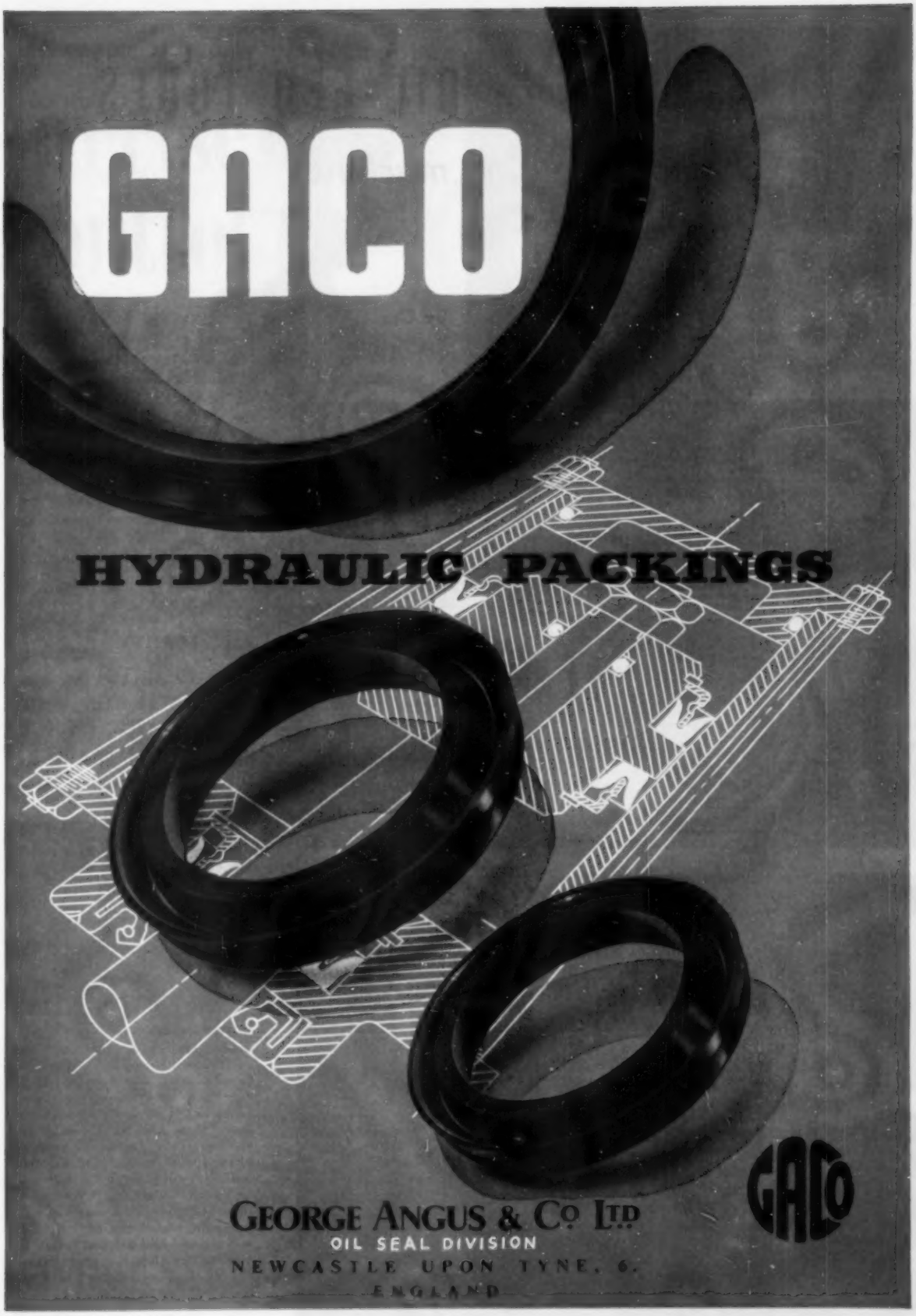
Good practice dictates that all 110-volt control equipment be located to the side or below the line-voltage equipment—*never above.* It is not unusual for the electrician to drop a metallic tool when checking relays. This can result in a serious accident if the relays are not located properly.

For maximum protection, relays as well as other controls, should be mounted at least 24 inches above the floor and not higher than 60 inches. This locates the control equipment where the maintenance man can work most efficiently and safely.

Relays should be mounted so that they can be easily wired and serviced or replaced. Wiring duct is very useful for this and also presents a neat panel. Wiring time with duct is usually much shorter than with lacing.

On standard or semi-standard machines there may be auxiliary operations that will not be required by all users. In maintaining a standard relay layout, all possible operations should be considered, keeping locations for the relays of the auxiliary operation blank if not required. This also permits the addition of auxiliary operation in the field with a minimum of trouble and downtime for the machine. ▼▼▼

(Part 1 of this article appeared in March.)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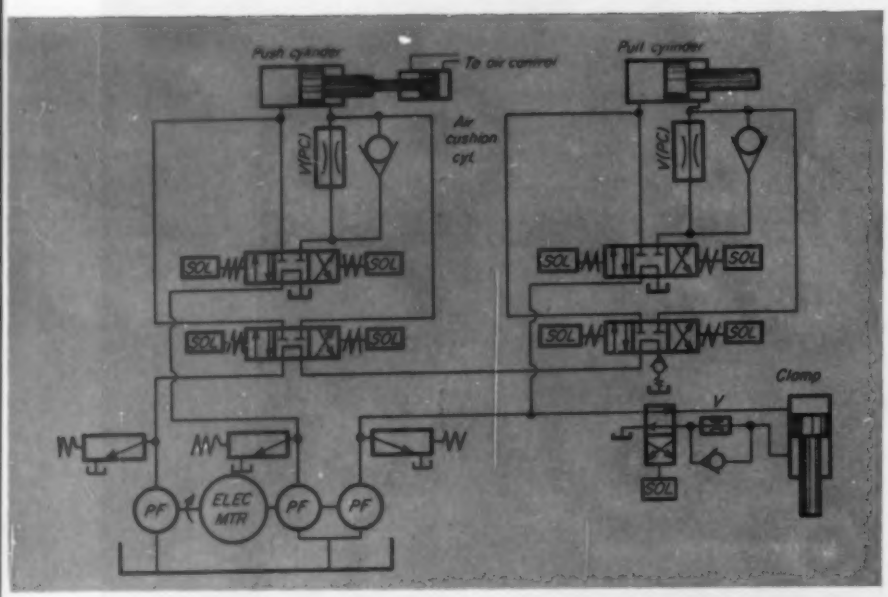
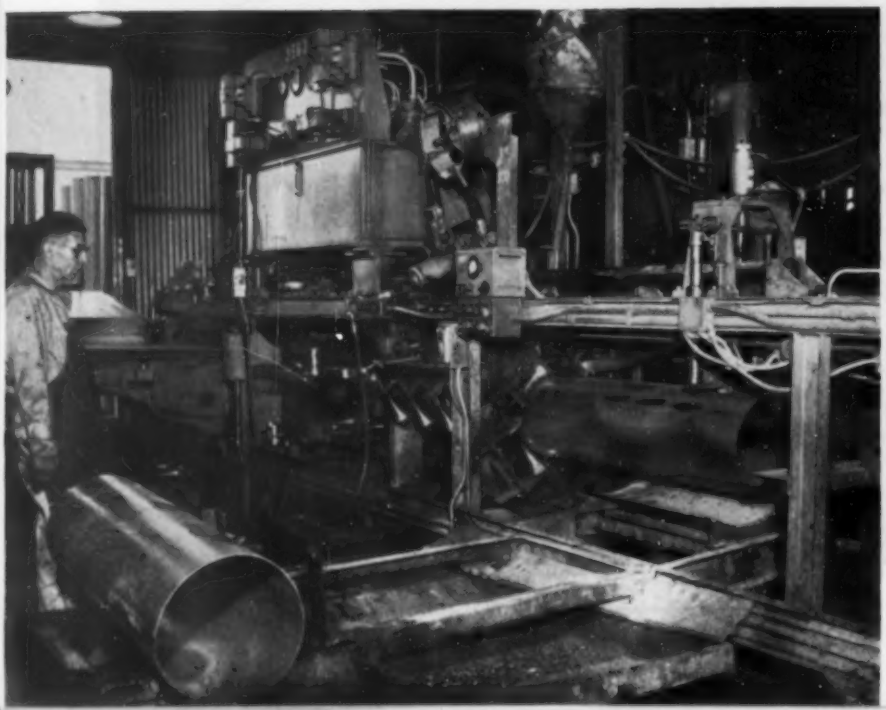
• By Ora L. Sams





Production welding on outside seam of light gauge tubing requires smooth movement at constant speed during the welding operation, and rapid movement for loading and unloading. To keep the ends even, the following tube must stay in tight contact with the one being welded. The problem is further complicated when the tubing varies in lengths and sizes. All requirements were successfully handled with skillful use of air and oil cylinders. Every 27 seconds, one 4 ft long 12 in diameter 13 gauge tube is completed.

• **Feed control**—A low pressure air cylinder was placed between the pushing hydraulic cylinder and the carriage that pushes the tube. Size of this air cylinder is very important. It acts to cushion the advance

Concluded on page 104

ORA L. SAMS, *Supervisor, Tool Room, Day & Night Division of Carrier Corporation, Monrovia, California.*

WHILE ONE TUBE is being welded, the next one must be swiftly brought up against it and firm contact maintained. However, the tube ahead must not be struck with force enough to move it or the weld would be spoiled. This control is accomplished with a cushion air cylinder mounted with the hydraulic push cylinder. When one tube is pushed up against the preceding tube, the air cylinder is retracted and a limit switch is actuated to slow the push cylinder to feed speed for welding.

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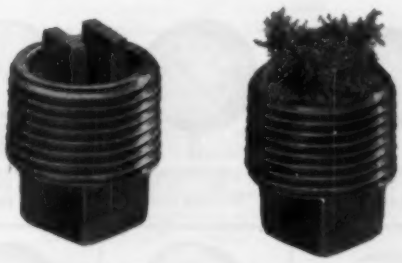

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AIR CUSHIONS OIL FED TUBES

Concluded from page 102

of the push cylinder so that just enough power is developed to push the tube up to the weld station or against the tube ahead, but not enough force to jar the tube ahead. Movement of the air cylinder operates a limit switch, to put the hydraulic cylinder from rapid traverse into feed speed.

The push and pull hydraulic cylinders travel together until the forward tube is past the weld point. Then the pull cylinder releases the tube and retracts at high speed to the starting position to pick up the next tube.

• **Sequence**—As a sheet is rolled into a tube, it strikes a limit switch operating an air cylinder that pushes the tube into the welder. When the air-operated roll pusher reaches the end of the stroke, it contacts a limit switch that starts the hydraulic push cylinder travelling at high speed until it pushes the tube up to weld point or contacts the end of the preceding tube. As it makes this contact, enough pressure is exerted against the end of the tube to compress the cushion air cylinder and actuate a limit switch, immediately slowing the push cylinder to feed speed.

Welding starts when the first tube's lead end passes the weld point. Push cylinder continues to feed the tube forward to the limit of its stroke and contacts a switch operating the roll feeding mechanism. Another sheet is fed into the roll and pushed into the welding machine for pickup by the push cylinder.

As the tube is pushed through, the tube end actuates a limit switch on the pull cylinder jaws. This switch energizes the hydraulic cylinder that clamps the jaws onto the tube end. It also starts the hydraulic pull cylinder forward at feed speed. Both cylinders travel together until the push cylinder completes its stroke and contacts a limit switch. It then reverses at high speed and returns to the starting point.

When the pull cylinder has carried the tube the proper distance past the weld point, it actuates a limit switch. The clamping jaws open and the cylinder starts forward at high speed. During its travel it contacts other switches that break the weld between the two tubes and the tube is ejected from the machine. When the cylinder reaches the end of its stroke, it reverses and returns to the starting point.

• **Fluid power**—Hydraulic power is provided by three hydraulic pumps. One, low presure, high volume unit handles fast travel; and two, high pressure, low volume pumps supply oil for cylinder feed. ▼▼▼

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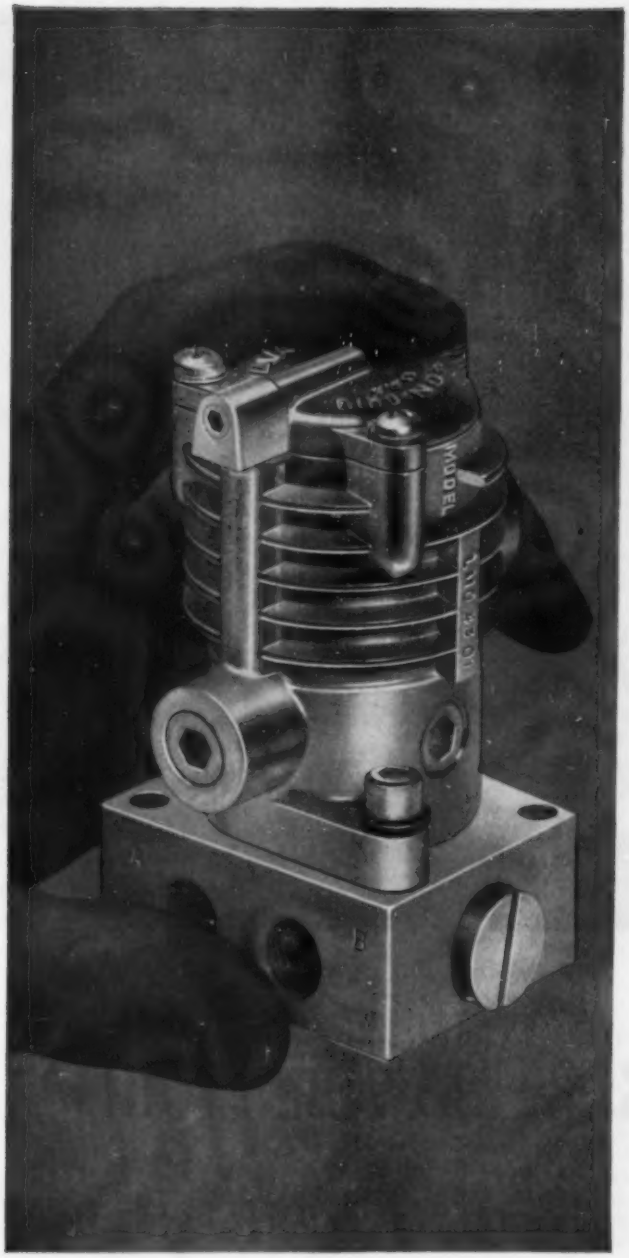

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4-PLUNGER VALVE CIRCUIT

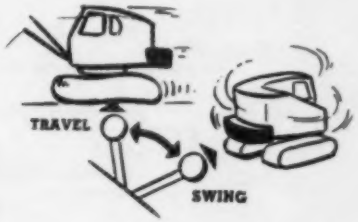
...controls crawler shovel

INCREASED operating ease and quicker response were added to crawler-mounted power shovels by application of hydraulic power. The new hydraulic system replaces a mechanical system of levers formerly used for crawler steering, tread locking pawls, shifting of swing and travel jaw clutches and house lock. Steering is accomplished by a cylinder which actuates clutches to lock one crawler while the other drives to produce a pivot turning motion. The tread locking pawls lock both crawlers so that the shovel cannot move forward or backward. The swing and travel clutches control forward travel of the shovel and rotary swing of the turntable. The house lock prevents rotary motion of the turntable.

The hydraulic controls consist of four short throw levers compactly assembled in a conveniently located manifold near the hoist lever. The circuit consists of a belt-driven, gear type pump mounted

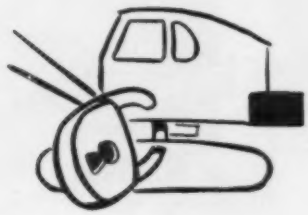
1

LOCKING PAWLS—These pawls lock the crawler tread belts to prevent any forward or backward motion of the machine during operation. Two locking pawls are provided and each is normally held in locked position by a spring which can be released by hydraulic pressure through the single acting cylinder.



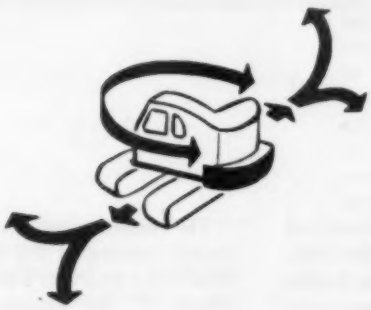
2

SWING AND TRAVEL JAW CLUTCHES—This part of the circuit actuates the jaw clutches controlling the swing and travel of the machine. With hydraulic pressure released from the cylinder, the swing jaw clutch is engaged so that power from the engine is provided for the power flow used in swinging. When power is introduced into the circuit, the swing jaw clutch is disengaged and the travel jaw clutch is engaged so that the operator may travel the machine backward or forward as required.



3

HOUSE LOCK—Spring return cylinder keeps lock normally engaged, preventing any side motion of the turntable. Plunger is pulled back and cylinder is retracted to release the lock.



4

CRAWLER STEERING—Double acting cylinder actuates sliding jaw clutches on the horizontal propelling shaft. These are used to steer the machine. A steering clutch is provided on each side for each tread belt. When the sliding clutch on either side is engaged in the locking clutch, the tread belt on that side is locked while the other tread belt is driven. This provides for pivot turns. There is a special secondary circuit opening into central by-pass of the valve. With plunger in neutral position both cylinder ports on the steering cylinder are connected to the tank so both sliding clutches are released and slide into proper engagement to produce straight-ahead travel.

directly on the engine. This provides power for one double acting cylinder and three single acting cylinders with spring return. A standard parallel circuit type control valve is used so all plungers can be operated at the same time if necessary.

Use of hydraulics on this equipment has considerably increased its efficiency. Large mechanically operated levers were formerly used, and it took more than a minute to complete the cycle from swing to travel and back to swing. This same operation is now accomplished in a matter of seconds. ▼▼▼

MACHINE TOOL TRACER CONTROL

. . . made from standard four-

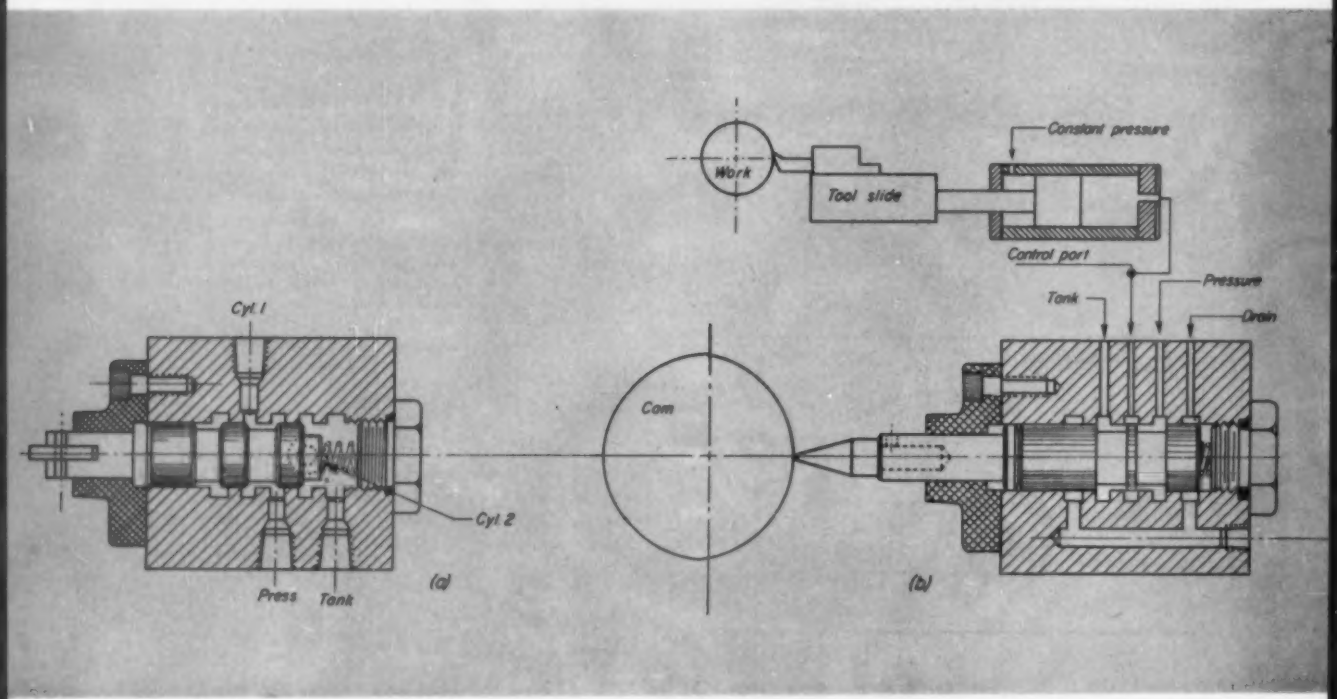


FIG. 1. A STANDARD four-way valve, *a*, serves as a sensitive and accurate tracer valve when modified as shown at *b*. Both valve body and spool were reworked. The valve shown was used because of the accurately finished porting and the two-piece spool construction which simplified the necessary modification. Left end of the valve spool was reworked to permit quick changing of the stylus to match the job being traced. Note the underlap of the center land of the valve spool. This is necessary to obtain smooth control.

MODIFICATION of a standard closed-center, four-way valve, Figure 1*a*, resulted in the highly satisfactory tracer control valve shown in Figure 1*b*. Two of these valves are used to control workpiece feed rate and tool slide feed on a hydraulic duplicating lathe. The circuit, using constant pressure at one end of the feed cylinders while flow in or out of the other ends of the cylinders is controlled by the tracer valves, provides very accurate and fast response.

The valves were developed to permit turning of the inner race of a roller bearing, Figure 2. Because of the extremely rapid changes in contour of this part, it was impossible to follow the part outline on a template or the actual part while maintaining a constant workpiece feed rate. Therefore, both feed and cross slides are controlled through the tracer valves and cams. Cams are driven by a small constant-speed hydraulic motor. Thus the slides may be moved in unison or one held while the

way valves

• By Paul B. Walton
and William F. Morgan

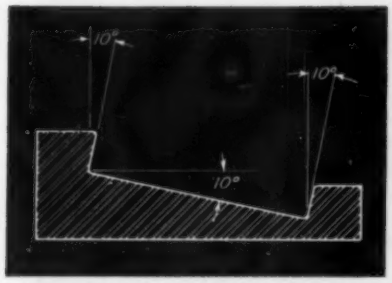


FIG. 2. SHAPE OF THIS roller bearing inner race dictated that both workpiece feed and cross slide feed be cam controlled. Cams for the piece shown reduced feed almost to zero while cross slide moved in or out of the deep cuts.

other is moved to provide any shape desired.

When shape of the workpiece permits, a template may be used to control crossfeed while the workpiece feed rate is constant. The machine may also be used for non-duplicating work by locking the cross slide and using a constant rise cam to actuate the work feed valve.

▼▼▼

PAUL B. WALTON *and* WILLIAM F. MORGAN, *Research and Development Dept., National Acme Co., Cleveland, Ohio*

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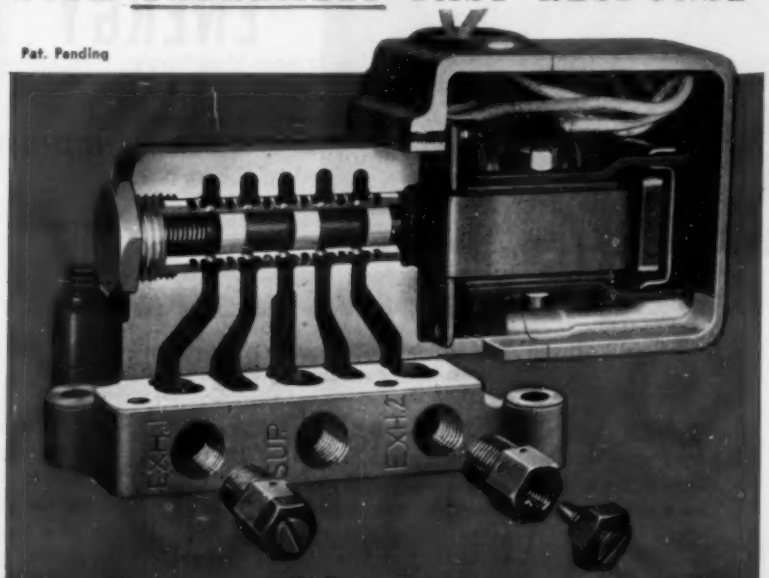

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HYDRAULIC ENERGY ABSORPTION

. . . . *improves shock absorbers*

● By John A. Lankester
European Editor, APPLIED HYDRAULICS

A NEW railway car shock absorber or buffer, Figure 1, developed in Britain by Dowty Hydraulic Units Inc. shows considerable improvement over previous devices used in this application. Advantage of this unit over earlier devices is that it absorbs and dissipates energy as heat rather than storing it by compression of a spring. This is done by forcing fluid through orifices into a reservoir.

When a spring is used as a buffer, resistance of the buffer is directly proportional to the amount of compression of the spring or buffer. With the hydraulic unit, resistance of the buffer is related to the speed at which the buffer is compressed. Therefore, this design is self-adjusting for changes in impact due to variation in car speed.

Among the interesting features of the design are the use of a completely sealed system and a system for preventing excessive pressure on the dynamic O-ring piston seal. The completely sealed system of course, reduces the possibility of fluid losses or contamination. In addition, sealing causes air in the reservoir to be compressed while the piston is forcing fluid into the reservoir. This compression pressure is approximately 100 psi and helps to return fluid from the reservoir to the cylinder when the load is removed from the unit. Pressure on the O-ring piston seal is limited to this 100 psi value by a groove adjacent to the high-pressure side of the O-ring groove which intersects a number of holes leading to the reservoir. This results in an extremely low wear rate for the O-ring. ▼▼▼

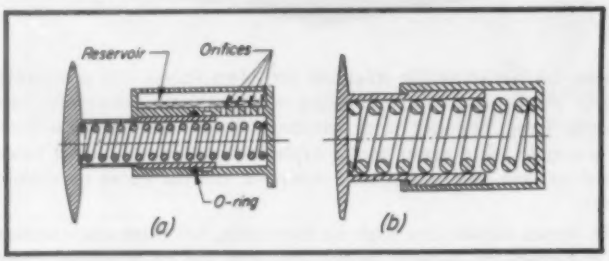

FIG. 1. CROSS-SECTIONS of hydraulic buffer, a, and helical spring type, b. Retarding force in the hydraulic buffer is provided by the piston forcing fluid into the reservoir through the restricting orifices.

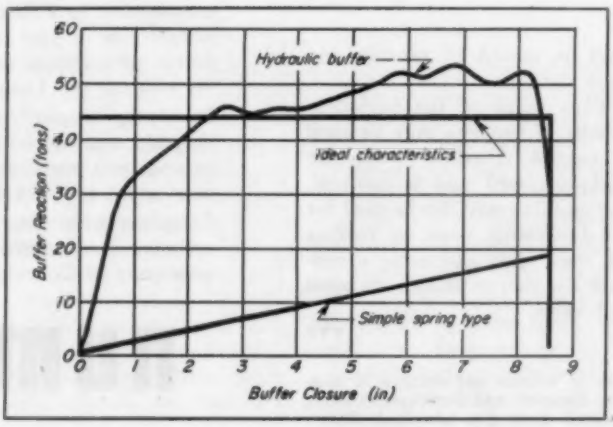

FIG. 2. HYDRAULIC and helical spring buffer characteristic compared with ideal characteristic for such a device.

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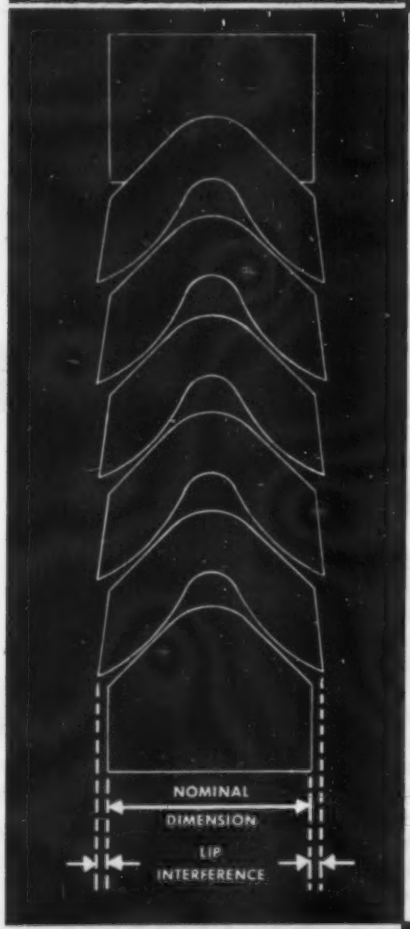

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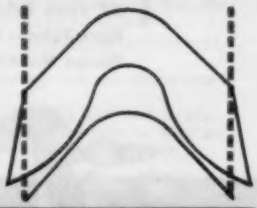

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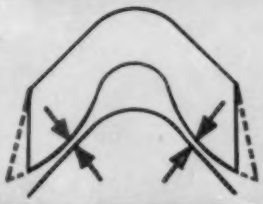

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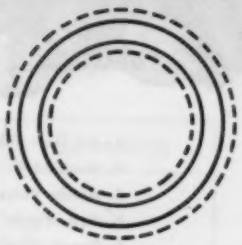

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HYDRAULIC POSITION CONTROL

Concluded from page 70

line closed hydraulic circuit in which a piston in the transmitter is connected by a copper tube to a piston in the receiver. Opposing springs of equal force in the transmitter and receiver maintain a constant pressure against the pistons. The spring in the receiver compresses when the spring in the transmitter decompresses.

The transmitter incorporates a synchronizing valve to compensate for volumetric variations in the fluid resulting from temperature changes or oil leakage. The transmitter contains a reservoir, and by moving its control arm through the 7 degrees of overtravel, the reservoir synchronizing valve is opened, thereby permitting fluid to flow to or from the reservoir. A maximum torque output of 400 in-lbs, at the transmitter shaft and a rotational movement of 55 degrees of both the transmitter and receiver arms provide the system with the necessary positive reactions of the walking beam mechanisms and movement of the valve spools required for trouble-free, automatic operation of the Hydra-Slinger in the foundry. The system also incorporates a safety feature in that the receiver is mounted in such a manner that its lever will automatically move the actuated mechanism to a safe position if the tubing connection is accidentally fractured and pressure is lost. ▼▼▼

CHECK VALVES

Concluded from page 73

used in a critical location is in a plastics injection molding machine. The check valve is installed as a bypass around a metering valve to permit return flow from the plunger cylinder. A leaking check valve would interfere with proper speed control.

Air-operated clutches and brakes on punch presses use check valves where the safety factor is of great importance. A storage tank acts as a safety device supplying air under pressure in case of a drop in line pressure or a break in the line. A check valve is installed ahead of the tank on the pressure side. If a drop in pressure, or a break in the line occurs, the valve checks to insure that the press comes to a normal stop position without stalling in the middle of a stroke, or being in a *down* position and causing injury to the operator or tooling. Any leakage through the check valve would drain air from the storage tank leaving insufficient volume to operate the clutch-brake in case of failure. ▼▼▼

COMING in the May issue of APPLIED HYDRAULICS
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O-RINGS

. . . cure date and age control

Over the years government agencies and the aeronautical industry have studied the problem of setting cure dates and age controls for O-Rings and other rubber parts. These studies are not completed, but some patterns are becoming established. This report will give hydraulic engineers the latest military specifications in their field.

• By Tommy McCuistion and E. M. Schaub
The Parker Appliance Company

Do you know the cure date life and age limitations of the O-Rings you are now using? This article provides ready reference charts with latest changes in the cure date life of O-Rings for hydraulic applications, as specified by the military services.

For reference to various military specifications, drawings and bulletins, Table 1 gives the more common O-Ring drawings and various data concerning age controls for these particular rings.

• **Problem**—Providing cure date and age control limitations for O-Rings and other rubber parts has been a problem for some period of time. To set age limits, it has been necessary to make many and varied studies to determine figures for these controls. These studies are still in progress. Engaged in this study are manufacturers of O-Rings, aircraft accessories, aircraft engines, airplanes, and the armed

Table I

O-RING DRAWING NUMBER	SERVICE	MATERIAL SPECIFICATION	AGE CONTROL DOCUMENT
AN 6227B	Hyd.	MIL-P-5516A Class B	ANA 427
AN 6230B	Hyd.	MIL-P-5516A Class B	ANA 427
MS 28784	Hyd.	MIL-P-18017A	ANA 427
AN 6290	Hyd.	MIL-G-5510	ANA 427

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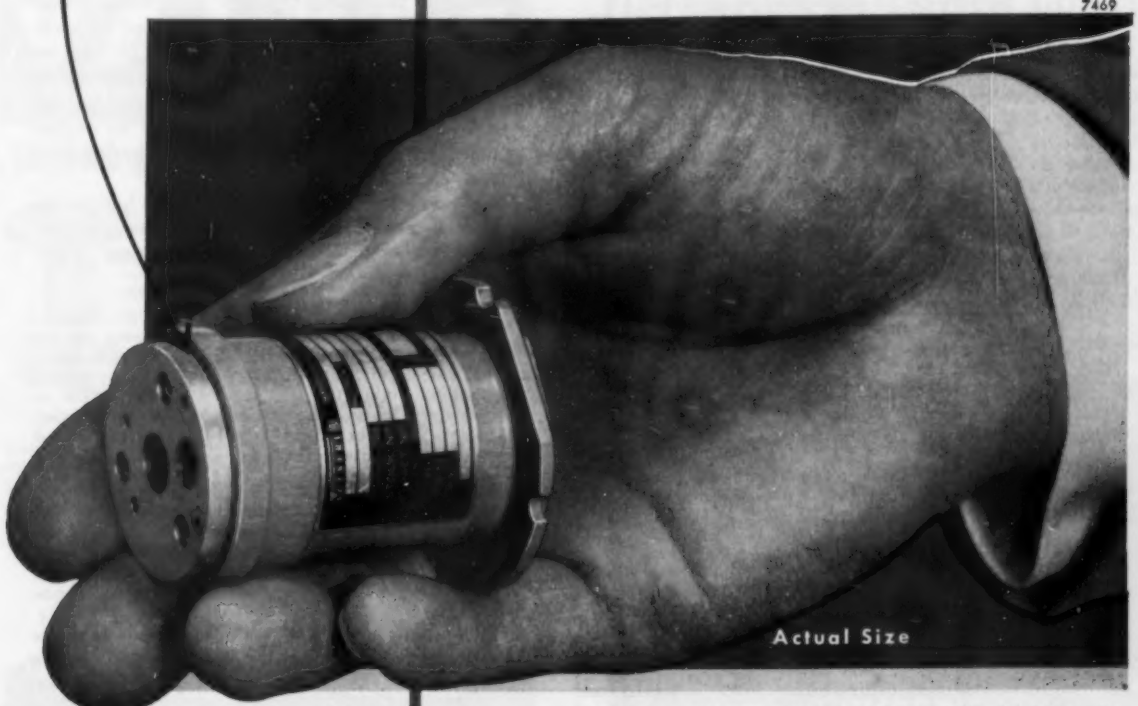

A large expansion program now in its early stages means large opportunities for additional engineers at Vickers. Write for information.

services. SAE Committee A-6 and the O-Ring Panel are very active in this field of study and research, and have acted as a clearing house to aid the armed services in their development of controls.

• **Quarterly system**—Original Bulletins gave cure dates and limitations in monthly units. The current Bulletin ANA 427, issued in August 1956, covers hydraulic rings and establishes age in terms of quarters. This quarterly system reduces inventory cost. The previous monthly cure date system required O-Ring manufacturers and users to check their stocks each month and scrap or replace any O-Rings that were beyond age limits. With the recently authorized quarterly cure date, this need only be done once every three months.

• **Storage**—It has been established that uninstalled O-Rings, properly stored in a carton away from excessive heat or cold, are almost as good as new even after five years. In some bulletins the government allows O-Rings to be used that are as much as four years old, if they have been stored and cared for as mentioned.

Table 2

	Maximum Accumulated Age in Quarters
1. From Cure Date of O-Rings to:	
(a) Receipt by Equipment or Aircraft Contractor Subcontractor, or Government in uninstalled condition.	4
(b) Receipt by Government as uninstalled spare parts or in kits of parts.	6
(c) Installation by Equipment or Aircraft Contractors or Subcontractors in Components or in Systems.	8
Note 1—The age control of a component containing synthetic rubber O-rings shall be based on its Assembly or Reassembly Date. This date shall be suitably recorded on the component and on the exterior package by quarter of year and year, to facilitate enforcement of the following age limitations:	

	Maximum Accumulated Time from Assembly Date in Quarters
2. From Assembly date Recorded on Component to:	
(a) Receipt by Aircraft Contractor or Government of uninstalled component.	2
(b) Receipt from Aircraft Contractor by Government of Uninstalled component as a spare.	6
(c) Receipt by Government of Component Installed in Aircraft.	8
Note 2—Packaging and Gaskets which are over 5 years (20 quarters) old, from cure date recorded on package, shall be considered OBSOLETE and shall not be installed in aircraft hydraulic and pneumatic systems or components.	

While O-Rings in an uninstalled state have considerable life, rings that have been installed in assemblies or sub-assemblies present another problem. After installation, the rings are usually under a certain amount of stress, and the aging of these rings is believed to be somewhat accelerated. Also, in the assembled state these rings may come in contact with the oil or fuel being sealed, which may reduce the life.

• **Cure date**—Bulletin ANA 427 (hydraulic) bases its cure date on the life of the ring until it is installed in a separate assembly. Then the assembly date becomes the age determinant. At time of installation into an assembly, the ring is given an automatic age of 24 months, or 8 quarters. This pattern is believed by most experts to be the proper pattern for any cure life or age control limitations set-up in the future.

One of the present problems confronting O-Ring manufacturers is the fact that various companies have set up their own particular requirements in order to allow themselves the maximum amount of time in which to use the O-Rings or ship their own assemblies. Basing the life of the O-Ring from its assembly date should tend to eliminate this problem and help the O-Ring manufacturer comply with special control requirements from each different manufacturer. Also, the manufacturer and assembler will be able to reduce the amount of paper work, and stock rings with a reasonable amount of time being allowed for their usage.

• **Hydraulic seals**—With reference to aircraft hydraulic and pneumatic O-Rings, ANA Bulletin 427 sets up age limitations for seals produced to drawings AN 6227B, AN 6230B and MS 28784 (see Table 1). At this writing none of the controlling military specifications have been modified to call out ANA 427, but letter authorization to deviate from the specifications has been issued by the military services.

Again, the cure date of the O-Rings follows the quarterly pattern, However, there are two important differences to be observed in the case of hydraulic seals.

1. In determining acceptability, age accumulation is started in the 3-month period *following* the calendar quarter in which the parts were manufactured. Consequently, aircraft hydraulic O-Rings produced (156) during the first quarter of 1956, have an elapsed life of one quarter as of the second calendar quarter in 1956. This seal is acceptable through the first quarter of 1957, as being the maximum four quarters old.

2. Once aircraft hydraulic O-Rings have been assembled, the initial cure date is no longer of any effect. Elapsed cure life is assumed to be 8 quarters at this point, and basis for future acceptability of the installed O-Ring becomes the assembly date.

In the past it was necessary to provide separate certificates and markings on components covering both cure and assembly date. This last provision

obviates the necessity for O-Ring users to require freshly produced seals, as one-quarter-old parts are considered the same as pieces aged up to seven calendar quarters, once the O-Rings have been installed.

Another important implication is that it affords six full quarters to the aircraft or component manufacturer in which to ship any government spare parts requirements. This tends to eliminate some scrapping of over-age O-Rings.

Table 2 gives the age limitations imposed on aircraft hydraulic O-Rings at various stages of use.

Current O-Ring age controls are quite specific and realistic in their approach to the problem at hand. They should help eliminate much of the confusion that existed in the past. ▼▼▼

ABBREVIATIONS EXPLAINED

MS—(previously "AN")—drawings issued by the military service. These have been coordinated with other government branches to represent standard sizes frequently used.

MIL—permanent specifications published by the military services defining various characteristics of materials involved.

ANA—bulletins issued by Air Force-Navy Aeronautical Board. Not coordinated with other government branches. Cover specific problems in more detail than MIL specifications. Once an ANA bulletin has been issued, manufacturers and their customers may obtain deviations to military specifications.

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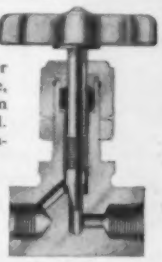

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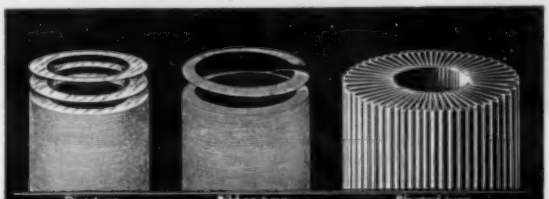

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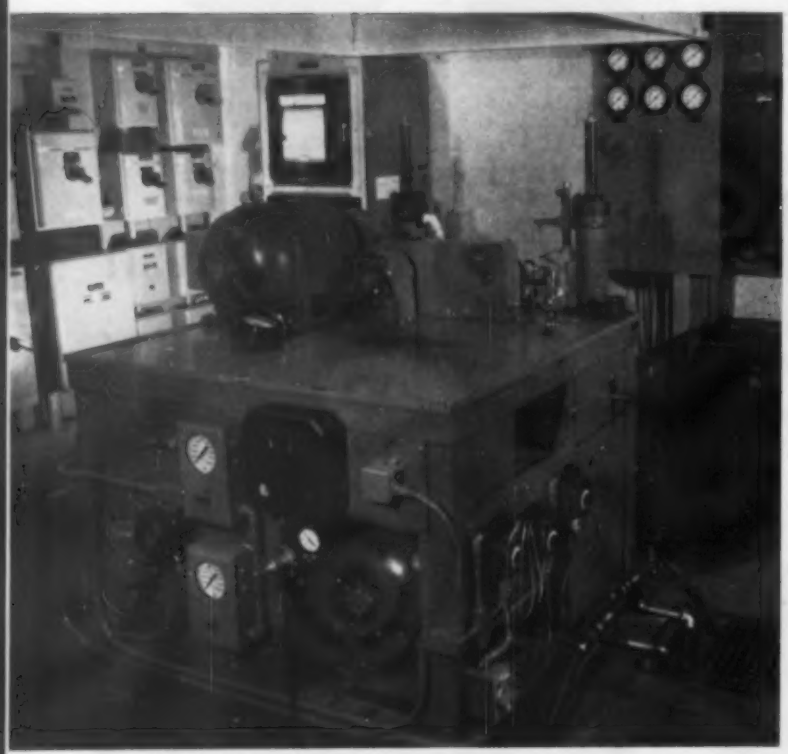

TEST TABLE is very compact. All components and controls are in this one package, except for flowmeters, pressure switches, reactors and transformers. These are located against the walls, permitting free movement around the table.

• By L. H. Smith

TEMPERATURE effects on equipment, fluids and general performance are very important in testing hydraulic and pneumatic equipment for use in modern high speed aircraft and missiles. Laboratory equipment should be safe, reliable, adaptable to various operations and easily controlled.

This table requires little space and gives rapid and accurate temperature control. Lower temperatures prevailing in control portion of the system give longer life to the standard components and fluids. Equipment has a temperature range from room temperature to 700 degrees F, and operates at pressures up to 5000 psi, and flow rates up to 10 gpm. Temperature in the fluid reservoir and pressure equipment does not exceed 300 degrees F.

Unit has accumulated over 300 hours of trouble-free operation. One quarter of the time was at temperatures above 400 degrees F, with peak oil temperatures of 560 degrees F delivered to test equipment.

• **Engineering features** adapted to the test table system shown in Figure 1 include:

1. An electric heater with a coil of stainless steel tubing as a resistance element. Delivery oil at desired pressure is passed through the coil.
2. A counter flow heat exchanger to heat low temperature delivery oil with high temperature return oil.
3. Use of standard normal temperature equipment by maintaining

L. H. SMITH, *Fluid Power Equipment Unit, Advanced Mechanical Control Engineering, Schenectady Aircraft Products Department, General Electric Company.*

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low oil temperatures in the system where pressure pumps, regulators, relief valves, and oil reservoir are located.

• **Flow Pattern** is shown in Figure 2. Low temperature oil passes from a 10 gallon stainless steel reservoir through a small supercharge pump to the main pressure pump. This is a 10 gpm, 5000 psi piston pump. Pressurized oil passes through the heat exchanger, receiving initial heating from hot return oil and continuing to the electric heater. The heater consists of 540 feet of stainless steel tubing wound into 6 concentric coils and welded together. It receives electric current through a saturable reactor control system.

In the test area, heat rejected from equipment being tested is utilized as additional heat for reheating the cooler oil. From the test area the oil returns to the heat exchanger, where it is cooled as it supplies initial heat to delivery oil. Oil temperature is further decreased in a water-cooled heat exchanger before returning to the reservoir at the desired temperature.

• **Electric resistance heater** and its control are the principal features of the table system. As shown in Figure 3, the heater consists of 6 coils of tubing whose length is divided into an open-loop, delta-type resistance element with both ends electrically grounded. Three electric leads attached to the coils are in series with three 25kva, 120 v (79v-dc), single-phase saturable core reactors. The reactors are in series with the secondary winding of three 25kva, 120 v, single-phase transformers. The primary windings of the transformers are connected to the main supply of 460v, 3-phase a-c power. Current from the saturable reactors to the coils is controlled by a control panel and a thermocouple mounted in the oil at the cold outlet.

• **Coil design** is based on heat transfer from a solid tube wall to an internal fluid by conduction and convection. This gives conversion of electrical energy into almost 100 percent useful heat by using a steel tube as a resistance heater. The design criteria essentially becomes the amount of electrical power available and the desired temperature rise of the fluid as it passes through the tube.

Amount of heat transferred from tube to fluid may be determined from heat transfer equation:

$$Q = hA\Delta T \quad (1)$$

Where: Q = total heat transferred
h = heat transfer coefficient
A = area of heat transfer surface
ΔT = Temperature difference between heat transfer surface and bulk fluid

The amount of heat "Q" and the temperature difference ΔT are arbitrary values. In the heater design "Q" is 177,580 Btu per hour (52KW), the amount of thermal power necessary to raise 8.5 gpm of MIL-L-7808 type fluid 100 degrees F. The temperature difference ΔT, or fluid film temperature rise, is set at 50 degrees F to prevent early break-down of the fluid or deposits on the heat transfer surface.

The heat transfer coefficient "h" for this type of heat transfer is determined from the dimensionless theoretical expression:

$$\frac{hD}{K} = \phi \left(\frac{DG}{\mu}\right)\left(\frac{C_p\mu}{K}\right) \quad (2)$$

Where: ϕ = dimensionless constant
D = inside diameter of tube
G = fluid mass velocity
μ = fluid absolute viscosity
C_p = fluid specific heat
K = fluid thermal conductivity

A number of empirical expressions based upon type of fluid, fluid viscosity, and Reynolds number have been developed for the theoretical expression above.(1) The expression selected for the heater coil design is for liquids having viscosities not more than twice that of water, and Reynolds numbers exceeding 2100. It is:

$$\frac{hD}{K} = 0.023 \left(\frac{DG}{\mu}\right)^{.8} \left(\frac{C_p\mu}{K}\right)^{0.4} \quad (3)$$

The fluid properties of MIL-L-7808 type fluid at a flow rate of 8.5 gpm, a temperature of 500 degrees F, and in a tube of ½ inch inside diameter were used. With this information, the heat transfer coefficient "h" has determined and substituted into the equation $Q=hA\Delta T$.

With this data established, only the area A in the heat transfer equation remains to be determined. With "A" determined, and recalling the tube inside diameter as being ½ inch, the overall tube length becomes an easy calculation. As previously stated, the tube measures 540 feet and is fabricated into 6 concentric coils.

Electrical insulation between coils, coil spacing and suspension is provided by sections of laminated mica, notched and positioned between concentric coils. The coils are housed in a stainless steel cylindrical tank willed with dry vermiculite insulation to obtain maximum internal heat transfer.

• **Heat control**—The saturable reactor system provides continuous variable control of current delivered to the coils in accordance with temperature requirements. Reactor control is maintained by direct current from the reactor panel which controls the amount of current necessary to raise or lower the reactor impedance to alternating current flowing to the coils.

Fluid temperature is sensed by a thermocouple located at the heater coil outlet. Any change in temperature will cause a temperature control instrument in the reactor panel to change the voltage applied to the grid of a thyratron tube. This tube rectifies alternating current and controls the re-

(1) Heat Transmission, McAdams

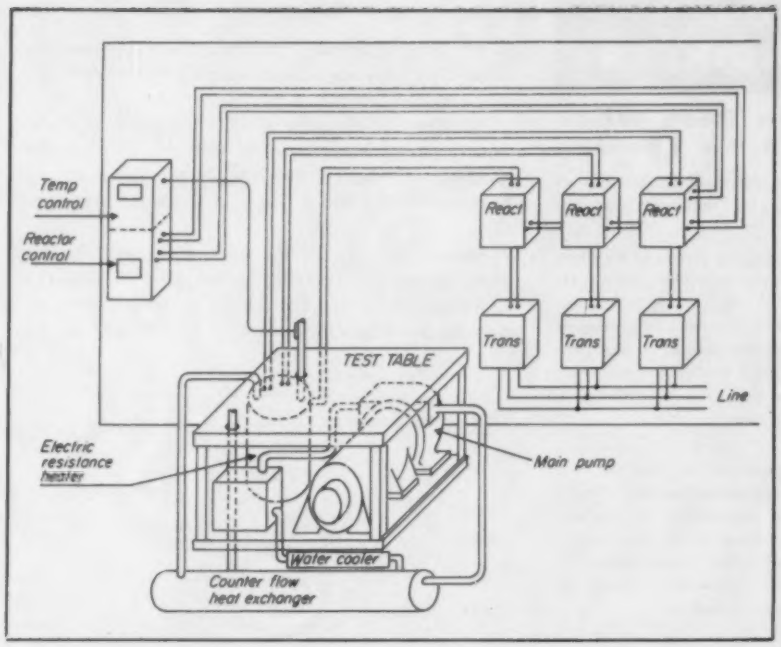
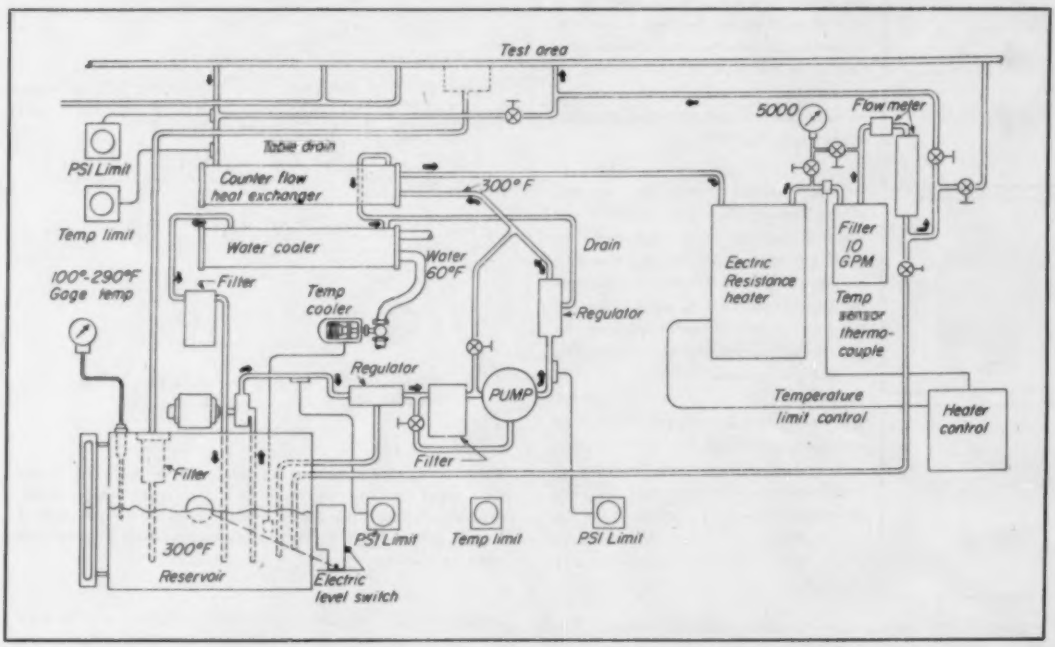


FIG. 1. Electric resistance heater gives quick, accurate control to 700 degrees F for oil in the test portion of system. Counterflow heat exchanger and water cooler keep temperature in rest of the system below 300 degrees F.

FIG. 2. Oil is pumped to the counter-flow heat exchanger, where it is partially heated, then to the resistance heater to be brought to desired temperature before reaching the test area. On returning through the heat exchanger, oil is partially cooled and then water-cooled to proper temperature before returning to the reservoir.



sulting direct current to the saturable reactors. Thus, smooth, "stepless" power is obtained in the heating unit with practically no possibility of overheating.

Equipment is capable of heating fluid at a rate of one degree per second, and will hold fluid temperatures within one percent accuracy over the full temperature range. In a recent test, a silicate ester base hydraulic fluid was used in a 7.5 gpm development pump test. The fluid was heated from 150 to 500 degrees F at an average of 23 degrees per minute.

• **Heat conservation** is so effective that little difference is observed between operating at slightly above room temperature and at 500 degrees F. The counter-flow heat exchanger is located below the floor level in a trench filled with dry vermiculite

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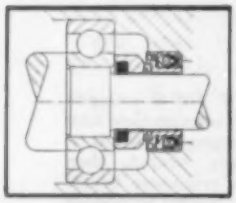
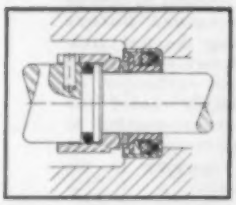
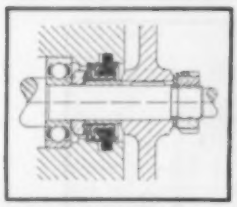
The typical examples shown below indicate the variety of methods possible in the application of mating rings for Sealol seals.



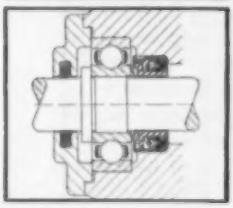
This mating ring is a push fit on the shaft. Interference is at the rubber packing, not metal to metal. The packing both drives and seals. Ring is squared by bearing or shoulder. Not recommended for high pressure applications as ring is hydraulically overbalanced away from shoulder. Seal is press fit in housing.



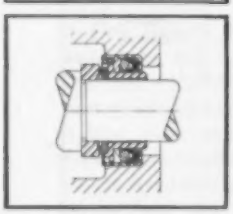
This mating ring is a slip fit on the shaft and positioned against shoulder. Ring is sealed to the shaft by the "O" ring in a groove and is driven by the pin. This ring is hydraulically overbalanced toward the shoulder and is, therefore, suitable for high pressure applications.



This mating ring is a close tolerance slip fit on shaft, held against bearing or shoulder by mechanical make-up. This make-up provides drive and leak-tightness to shaft. In this picture the seal is a slip fit in housing for easy assembly and removal and sealed to housing by an "O" ring.



This mating ring is actually the inner ring of the bearing. The inner ring must be mounted leak-tight to the shaft and positively driven (press fit). The ring face must be lapped flat and smooth. This arrangement saves space but its use is limited by the amount of frictional heat input the bearing will accept and by the limitation of choice of material.



This mating ring is a press or shrink fit on the shaft, positioned by shaft shoulder. This method requires close tolerance dimensional control of shaft and ring hole diameters. Since press or shrink fit can distort previously prepared face, this type ring is recommended only when other solutions are not practical.

These examples illustrate the necessity for decisions. The Sealol Engineer can make these decisions for you based on intimate knowledge and experience. Consult him for solutions of your shaft sealing problems.

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to provide maximum transfer of heat between the fluids. Asbestos tape insulates all exposed hot tubing.

As a result, electrical energy required to maintain constant temperature is reduced. The amount of electrical energy required is only to make up heat transferred to the water in the heat exchanger.

• **Safety apparatus** throughout the system provides automatic control. In addition to separate limit controls within the reactor control system, an over-temperature limit switch is located on the

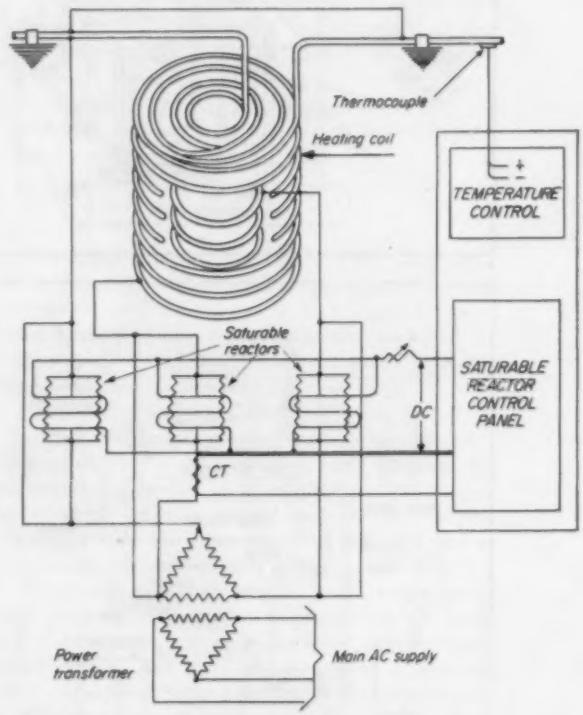
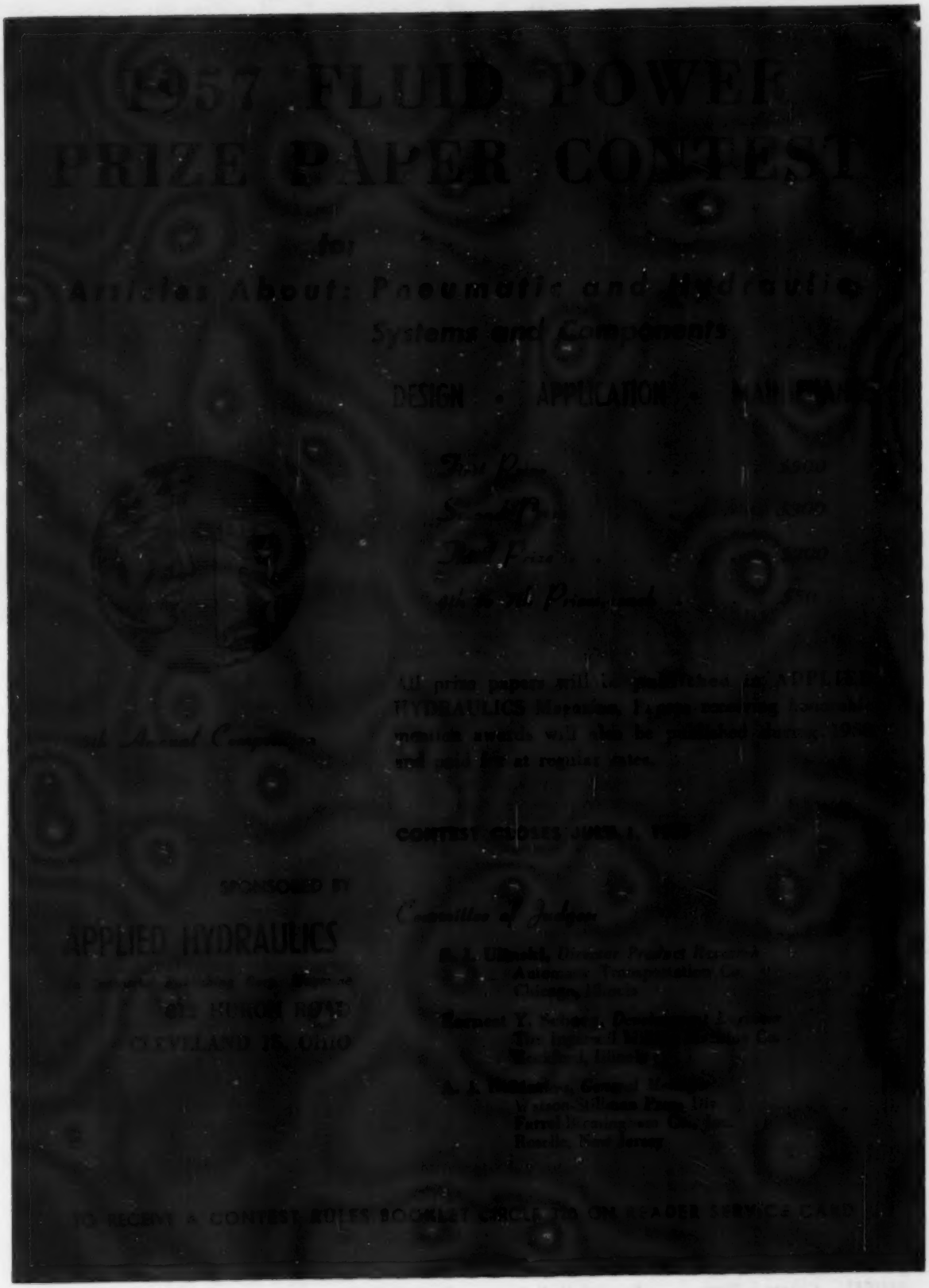


FIG. 3. Electric heater consists of 6 coils of stainless steel tubing divided into an open-loop, delta-type resistance element with both ends grounded. Leads attached to coils are in series with 3 saturable core reactors.

heating coil. Temperature limit switches are located in other critical areas. Small milliamp fuses are connected in parallel with each safety apparatus circuit to indicate the cause of malfunction. Any switch that causes the table to shut down will short out a small fuse in parallel with it.

Use of established engineering concepts and standard equipment has removed the table from an experimental classification. It has been unnecessary to replace or alter any equipment, or the general arrangement, in a year and a half, with over 300 hours of operation. ▼▼▼

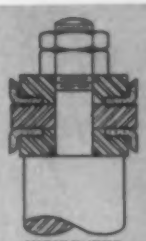
Photo and drawings courtesy of General Electric Co.

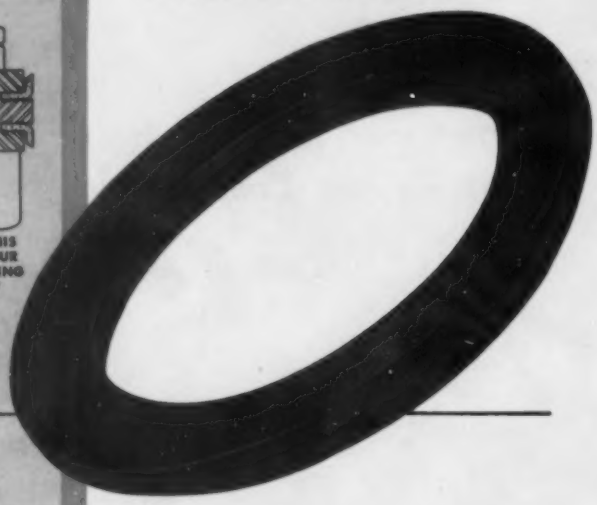

1957 FLUID POWER
PRIZE PAPER CONTEST
for
Articles About: Pneumatic and Hydraulic
Systems and Components
DESIGN
APPLICATION
SPONSORED BY
APPLIED HYDRAULICS

quality control

MARSH IMPREGNATED LEATHER PACKINGS

to your specifications

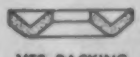


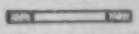


CUP PACKING

FLANGE PACKING

U PACKING


VEE PACKING


NON-EXTRUSION WASHER

DIAPHRAGM

Your packing problem—where quality control determines the successful application—has a solution! MARSH with more than half a century of experience plus continuous on-the-job and laboratory research, supplies the mechanical leather packing for your job—cut, formed, treated, engineered to meet YOUR SPECIAL REQUIREMENTS.

MARSH Field Engineering and Consulting Service, quickly available, helps you determine the specific leather packing for greatest efficiency, longer wear, lower cost — for your job.

MARSH PACKINGS, selected, tanned, impregnated to the job specifications, provide superior custom leather sealing with —

- **Low coefficient of friction** both static and running
- **Greater wear resistance** combining toughness with strength
- **Tighter sealing** proper impregnation for varied pressures
- **Temperature stability** through a wide range of temperatures

ENGINEERING and CONSULTING SERVICE

If you seal oil, water, air, vacuum, gas, gasoline, naphtha, alcohol, or other fluids, ask MARSH for field engineering service, immediately available to you for the job you are designing, tooling, manufacturing

WRITE FOR ENGINEERING HANDBOOK AND TECHNICAL LITERATURE

C. W. MARSH COMPANY

Main office and Factory Muskegon, Mich.

SALES OFFICES: 75 E. Wacker Drive, Chicago 1, Illinois · 101 Park Avenue, New York 17, N. Y. · 1900 Euclid Avenue, Cleveland 15, Ohio

New Products / continued

NEEDLE VALVES . . . use O-ring seal

Features: This series of small valves, both angle and straight pattern, is designed for instrument air lines, test panels, pilot-plant installations and graphic-panel boards. The O-ring stem seal prevents packing leaks and eliminates adjustments.

Specifications: Units are of forged brass with vee-point stem for accurate flow control, or blunt-point stem for full flow. Available bodies withstand 2000 psi and are of integral-bonnet construction. Choice of male or female pipe thread, or Swagelok tube ends. Available for panel mounting.

Hoke, Inc.
Englewood, N. J.

Circle 150 on Reader Service Card

AIR CYLINDERS . . . offer parallel mounting

Designation: Toolmor

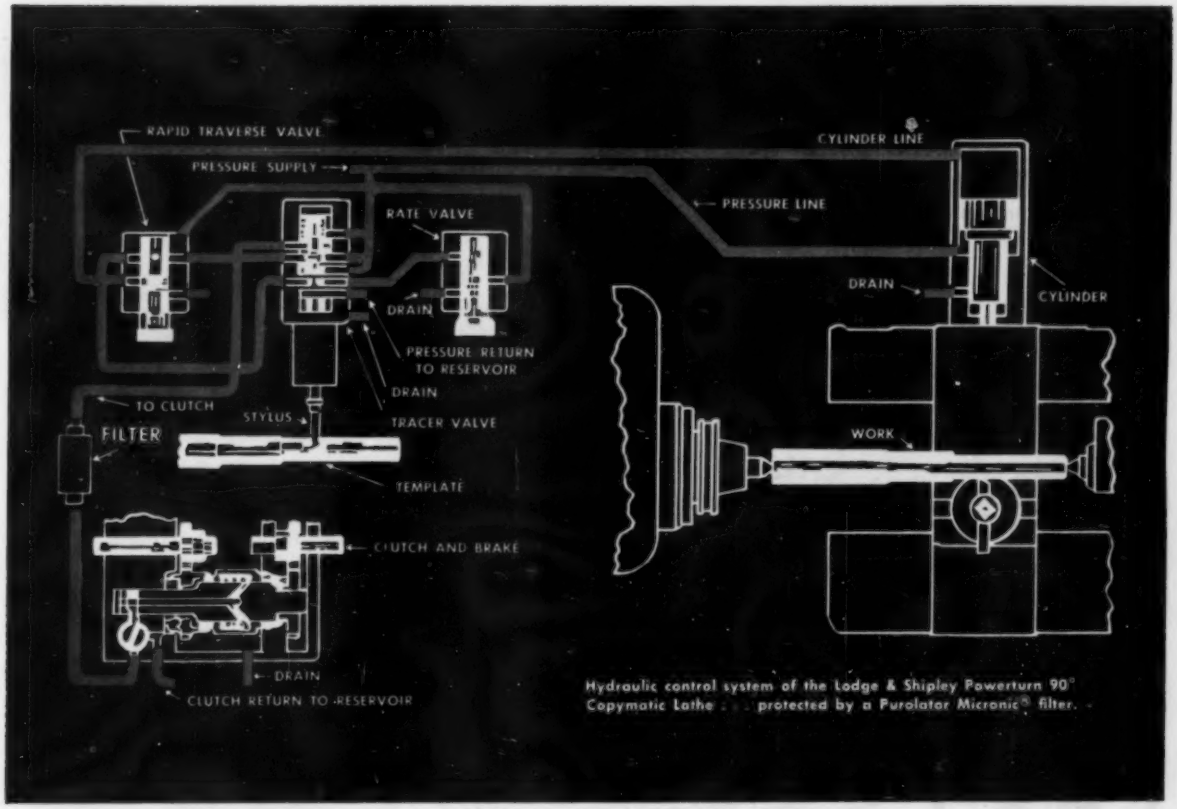
Features: Design provides very compact sizes in all strokes. Units give full, line-pressure power thrust with heavy, hardened steel piston for long life. Square and parallel sides make easy tooling installation and arrangement, permitting mounting to within 1/16 inch parallel of work. Universal mounting permits either horizontal or vertical thrust use.

Specifications: Units are available with standard, ball, swivel, threaded or tool blank piston ends, providing a selection of working tools in various length strokes, beginning with 3/8 inch.

Burklyn Co.
Los Angeles, Calif.

Circle 151 on Reader Service Card

Continued on page 126



Hydraulic control system of the Lodge & Shipley Powerturn 90° Copymatic Lathe . . . protected by a Purolator Micronic® filter.

Designed for highly accurate control ...fully protected by Purolator Filtration

On a very successful automatic duplicating lathe, this hydraulic control system makes possible both quick, simple operation and a high degree of sensitivity and accuracy. Reliable and uninterrupted operation of a system like this is dependent upon freedom from contaminants. That's why the Lodge and Shipley Company, its manufacturer, made Purolator Micronic® filters an integral part of their hydraulic system.

Purolator engineers recommended a standard filter from their stock of over 2000 models. It more than met the system's special requirements.

The controlled porosity of Purolator's Micronic element evenly filters out contaminant particles as small as .000039 inch. And because it's made of plastic-impregnated cellulose, the Micronic element is not affected by high temperatures, water, or oil.

PUROLATOR

PRODUCTS, INC.

"FIRST IN THE FIELD OF FILTERING"

Rahway, New Jersey and Toronto, Ontario, Canada

Filtering information for product designers is available in our 32 page "Filtration Manual for Product Designers". Just enclose 25¢ to cover postage and handling. Address Dept. PS-426

New Products / continued

PRESSURE CONTROL
. . . handles two circuits

Designation: J17A

Features: Unit provides two completely separate switch actions, permitting control of two independent circuits and extreme flexibility of switch arrangement. The control is not calibrated. Pressure settings are made individually on each switch by adjustment screws, accessible after cover is removed.

Specifications: Nine models are offered in adjustable ranges between 0 and 180 psi. Switches may be set together to simulate double-pole circuitry, or set apart to obtain independent operation. Wider differential between switches is available. Enclosure is die-cast aluminum with brass bellows housing. Unit is available normally open, normally closed, or double throw with no

neutral position. Rated for 15 amps at 115 or 230 volts ac. DC and 20 amps ac are available. Switch is wired to internal terminal blocks via a 7/8 inch opening.

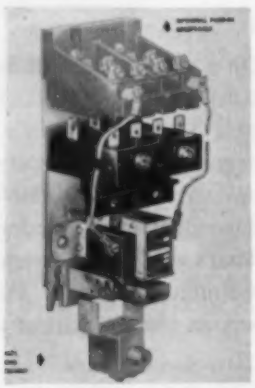
United Electric Controls Co.
Watertown, Mass.

Circle 152 on Reader Service Card

RELAYS
. . . feature accessibility

Designation: FMP & IMP

Features: Contactors can use conventional screw-clamp terminals or plug-in receptacles, permitting removal and replacement of entire unit in minutes. This minimizes down-time on high-output machines. An optional latching attachment allows quick conversion for use in memory, continuous-duty and other circuits. Converts from latch-in to latch-out operation in the field. Unit construction provides fast, easy inspection or replacement



of the coil and magnet. On removing two screws, entire assembly can be swung to the front and the coil and magnet lifted out.

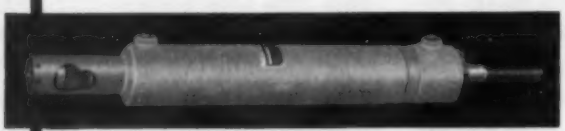
Specifications: Size 0 is rated at 15 amp, 600 v ac, and Size 00 at 10 amp, 600 v ac. Two types are offered: FMP—fixed multiple pole;

BHEW Custom-Built
HYDRAULIC CYLINDERS

Made-to-order to meet specific design requirements for any application in any industry.

Compactness! Efficiency! Close Tolerances! Outstanding operational performance! You get them all in BHEW cylinders. They require minimum mounting space. There is no tooling charge for BHEW cylinders, built to meet *your* specifications and delivered on schedule.

BHEW cylinders are available in standard and special O.E.M. designs . . . single or double acting and telescopic; 1½" to 8" bore; strokes up to 156"; oil hydraulic service in 1,500 psi or 3,000 psi working pressure, pneumatic up to 150 psi; cup-type, ring-type or O-ring construction; choice of mounting.



1 Cylinder barrel and non-adjustable gland welded into one piece, eliminates joint, makes small O.D. in large single and double-acting hoist cylinders.

2 Accurately honed barrel.

3 Hard chrome-plated rod.

4 Flow regulating or pilot operative check valve in base, when required.

Send us specifications of your requirements, for full information.

Got a design problem involving cylinders? Our extensive engineering service is available to you without charge.

BHEW Benton Harbor Engineering Works, Inc.
622 Langley Avenue, St. Joseph, Michigan

and IMP—interchangeable multiple pole. Both are supplied in a complete line with 2, 3, 4, 6 or 8 poles. All current-carrying parts are silver-plated.

Arrow-Hart & Hegeman Electric Co.
Hartford, Conn.

Circle 153 on Reader Service Card

HYDRAULIC JACK
. . . lifts 100 tons

Designation: 100B-12

Features: Unit is simple in design, ruggedly constructed and rated at 100 tons, with a lifting height of 6-1/8 inches. This jack is low in height, high in capacity, and suited for handling extreme loads as found in erection of heavy equipment, machinery moving and bridge building.

Operation: To permit rapid engagement of the load, this jack is equipped with a tandem pump. By actuating both high-speed and high-lift plungers, the operator quickly brings the ram in contact with the load. Using the high-lift plunger alone, the load is then lifted easily. Dual release valves in the base can be operated from either side, and the base is drilled and tapped for a pressure gauge.

Western Railroad Supply Company
Chicago, Ill.

Circle 154 on Reader Service Card

DIAPHRAGM COMPRESSOR
. . . has twin cylinders

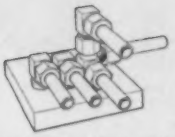
Designation: DP.14

Features: Unit is capable of continuous operation at 50 psi, and should have many applications where clean air supply is essential. Straight-line motion to central connecting point of the diaphragm gives long life.

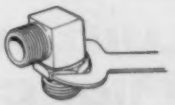
Specifications: Unit uses multi-ply, high-temperature, neoprene diaphragms, laminated with nylon.

Continued on next page

- Eliminates O-Ring
- Saves Space for Multiple Connections
- No Grinding or Special Seat Finishing Required—Coins own seat against machined step
- Requires No Special Tools
- Stationary Body Permits Lines to Remain Attached
- Unaffected by Temperature Extremes
- Permits Straight Line Connections
- All Conventional Shapes



Permits side-by-side installations on subpanels—*without special tools*—with ½" or less center-to-center spacing as shown.



Repeated installation or removal *—with ordinary wrench—*doesn't disturb hydraulic lines or fittings, and seal coins its own seat when nut is tightened.

PERMITS 'GANGING' OF FITTINGS

Machinery manufacturers can now design their product with all hydraulic connections concentrated in small space. One-half inch fittings, for example, can be located with one-inch or less center-to-center intervals for pumps, valves, panels etc. Cuts time, labor and maintenance costs.

REQUIRES NO SWIVELLING RADIUS

Because only the Floating Nut is tightened or loosened, no fitting swing is required. This permits snugging the fittings side-by-side in extremely small areas heretofore impossible. Even the lines can remain stationary during installation or removal.

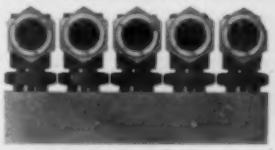


Illustration shows how compact, side-by-side installation runs were made by one large hydraulic equipment manufacturer.

WRITE FOR OUR NEW Metal-to-Metal Seal CATALOG MS-57

Ask Your Supplier to Furnish METAL TO METAL SEAL FITTINGS On Your Hydraulic Equipment

Performance-Proved by Manufacturers and Users

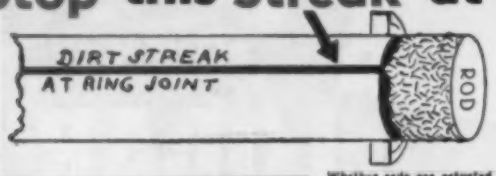
* Pat. Pndg.

FLODAR CORPORATION
16911 St. Clair Avenue
CLEVELAND 3, OHIO

Circle 38 on Reader Service Card

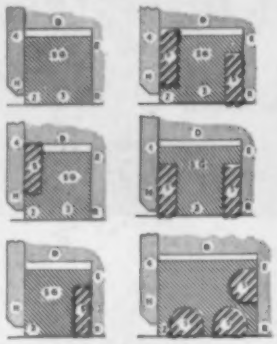
Circle 2 on Reader Service Card

Stop this Streak at the Joint with a Fall WIPER RING



CLOSED JOINT

Showing 6 of the many FALL "Closed Joint" Wiper Rings for Industrial Hydraulic and Air Use with "Squeeze Grip Action" on the piston rod.

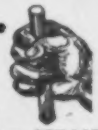


RING DESCRIPTION
SG—"Squeeze Grip."
2—Front side of ring
3—Closed Joint is in Ring.
4—Flange (or plate) holds ring in cavity.
5—Rubber seal compressed in restricted area.
H—Inside dia. of flange at bevel end (see #4 above).
D—Depth of Cavity for holding ring.
E—I.D. of cavity for holding ring.
R—Ring I.D. and/or rod O. D.

Whether rods are actuated hydraulically or by air, always specify the FALL "CJ" Wiper Ring for the "cleanest wipe this side of shaving". Available in bronze or cast iron in diameters upward from ½", the FALL "CJ" Wiper Ring removes slightest accumulation of dust, dirt or other abrasives ON THE ENTIRE O. D. of the rod and also prevents passage through the joint itself. All Fall rings are spring loaded and the

SPRING LOADED

Endless Spring in O. D. of Ring Maintains Continuous Squeeze Grip on the Rod



preventing ring from ever opening up, assuring "take up" of all wear automatically and eliminates build up of dirt under ring. Further, we factory lap each ring with our DRY-LAP process. This pre-actuating of the ring before packaging creates a "worn-in" true-circle which assures a "light tight" wiping edge immediately upon installation. Then by adding certain of our "rubber seal" features, all

SQUEEZE GRIP ACTION

DRY-LAP PROCESS

Moisture, Liquids are Sealed Out

SEALS OUT

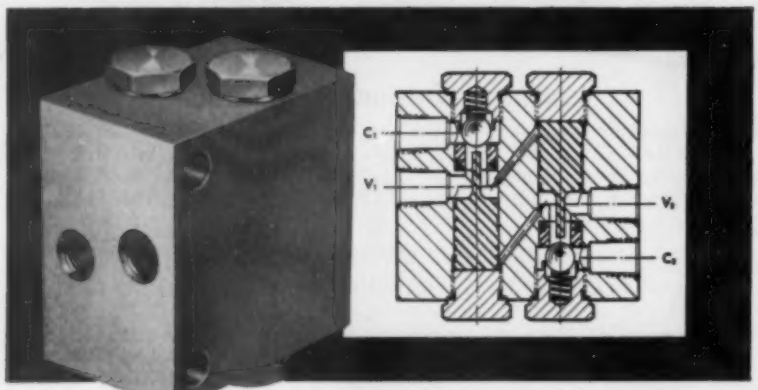
from entering bearings, bushings, etc., where possible damage may be done

We invite inquiries by letter, wire or phone. If you have a problem let us work with you in solving it.

All FALL Wiper Rings covered by patents issued and patents pend.

Ace Products Co., Toledo 1, Ohio. PH: CHerry 3-6513
You Can Depend on ACE Products—Established 1935!

FLUID CONTROLS Double Pilot Check Valves...



provide leakproof locking of double acting cylinders

- ¼", ⅜" and ½" Pipe Sizes
- For oil service to 3000 P.S.I.

Write For Detailed Literature

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

Fluid Controls, inc.

1284 N. CENTER STREET • MENTOR, OHIO

New Products continued

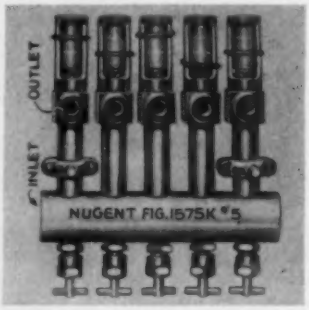
Free air delivery at 1500 rpm ranges between 7 cfm at 45 psi and 9 cfm at 10 psi, at 1.5 hp. Unit can be supplied integrated with a 400/440 v, 3-phase electric motor. Clutch or venturi-type unloader can be fitted for starting against load.

Hymatic Engineering Co. Ltd.
Redditch, England

Circle 155 on Reader Service Card

PRESSURE LUBRICATOR . . . offers close control

Features: Unit delivers lubricating oil, or other liquids under pressure, in accurately measured quantities to high or inaccessible points. Each lubricator making up a multiple unit is capable of feeding fluid in amounts varying from several drops to 2 pints per min by simple adjustment of the individual needle valves.



Specifications: Controls are available as single units or in multiples to 15. Single lubricators are available with ¼ or ⅜-in. ips inlet and outlet. Inlet sizes of multiple units range to ¾ in. ips with ¼ or ⅜-in. ips outlets. All are designed for 125 psi working pressure.

Wm. W. Nugent & Co., Inc.
Skokie, Ill.

Circle 156 on Reader Service Card

TEFLON TUBING . . . Is accurately cut

Features: Spaghetti tubing, both thin and standard walls, flexible tubing, rod and heavy wall tubing made from Teflon, are all cut in lengths to meet individual requirements for aviation, automotive and general industrial applications. Material is production cut, clean and square, without feathers or flattening, to a high degree of accuracy,

Continued on page 130

Circle 39 on Reader Service Card

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SEC. 34.9 P. L. & R.
CLEVELAND, OHIO

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1	18	35	52	69	86	103	120	137	154	171	188	205	222	239	256	273	290	307	324
2	19	36	53	70	87	104	121	138	155	172	189	206	223	240	257	274	291	308	325
3	20	37	54	71	88	105	122	139	156	173	190	207	224	241	258	275	292	309	326
4	21	38	55	72	89	106	123	140	157	174	191	208	225	242	259	276	293	310	327
5	22	39	56	73	90	107	124	141	158	175	192	209	226	243	260	277	294	311	328
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295	312	329
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296	313	330
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297	314	331
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298	315	332
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299	316	333
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300	317	334
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301	318	335
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	337
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

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3	20	37	54	71	88	105	122	139	156	173	190	207	224	241	258	275	292	309	326
4	21	38	55	72	89	106	123	140	157	174	191	208	225	242	259	276	293	310	327
5	22	39	56	73	90	107	124	141	158	175	192	209	226	243	260	277	294	311	328
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295	312	329
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296	313	330
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297	314	331
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298	315	332
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299	316	333
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300	317	334
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13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	337
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

EVER TRIED MACHINING A SPECIAL I.D. SHAPE?

—in stainless steel, with each part 22 inches long, the outside diameter a shade over 2 inches and with tolerances of +.000" to —.010" across the flats?

On jobs like this, there's possible trouble ahead if you start with solid stock, or even round heavy wall tubing. Machining problems, surface finishing, scrap loss, special cutting oils or compounds—added to the original stock cost may make the final cost of the part prohibitive.

There is one sure way of minimizing your production problems and costs involving hollow cylindrical parts and products—*DESIGN WITH B&W MECHANICAL TUBING.*

Before you start your next production run, call Mr. Tubes at your nearby B&W Tubular Products Division District Sales Office—let him match tubing steels, types, finishes, shapes and tolerances to your applications—he will show you how to keep final costs low. Or write for bulletins 361 and 340. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA-6086-M2

Seamless and welded tubular products, seamless welded fittings and forged steel flanges—in carbon, alloy and stainless steels.

Circle 126 on Reader Service Card

do you have a "tight seal" problem?

By tomorrow morning, this fella's problem will be solved, except for a headache. But if you have a problem with tight seals for metal-to-metal applications, it will take more than a good night's sleep—United's Metallic O-Rings, for example.

They fit any application calling for a positive, permanent seal against internal or vacuum pressures up to 10,000 p.s.i., in a temperature range from –70 to 1800°F. They are especially adaptable for sealing cylinder heads, air and hydraulic pressures, high octane fuels, vapors, gases, oils, solvents, chemicals, acids, vacuum and steam connections. Available in various metals and plating finishes, from ⅜" dia. to any size or configuration.

For free 22 page booklet describing United Metallic O-Rings, write (on your letterhead please) to Department H-2

UNITED METALLIC "O" RING CORP.
Dayton, Ohio • Box 1035
Division of United Aircraft Products, Inc.

New Products / continued

and to any length from ¼-in. up, with a minimum loss in footage. Time and material is saved, as assembly is made easier with ends not flattened.

Pennsylvania Fluorocarbon Co., Inc.
Philadelphia, Pa.

Circle 157 on Reader Service Card

ROLLER CHAIN . . . offers flexibility

Designation: LXS

Features: Bushed roller chain offers long life under severe drive conditions. The balanced design provides extra strength, increased wear resistance and wider application flexibility. Accurate sizing of full-round

INSTANT PRESSURE REGULATION
0 to 3000 PSI

Proven Superior in Comparative Tests

WITH THE *Futurecraft* **HI/LO HAND LOADER**

GENERAL SPECIFICATIONS	
Port Size	¼" tube per AND 10056
Pressures	Operating—100-3000 psi Proof—6000 psi Burst—7500 psi Minimum
Flow	Exceeds any other loader available
Operating Temperatures	– 65° to + 250°F
Weight	2½ pounds

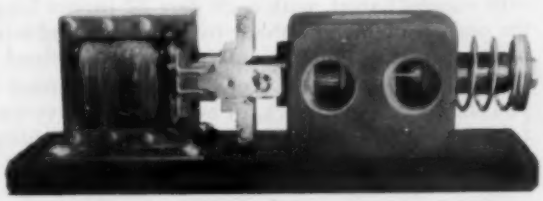
Futurecraft **CORPORATION**
1717 N. Chico Ave. • El Monte, Calif.
***WRITE TODAY** for complete details*

"After 3 million cycles on our life test, the Bachman Valve still did not leak and we have decided they are *good enough for our application.*"

This leading builder of automatic packaging equipment has now standardized on dependable Bachman Valves for their latest models.

If you are building prototype or pilot machines you can benefit right now from our immediate delivery and low prices—made possible by mass production techniques.

Chances are you will find Bachman Valves will open up new capabilities for you if reliable performance in a direct-acting large capacity valve is a requirement.



Bachman S-633, 3-way, 3 port valve for 200 psi.
¼ inch.....$12.75 ½ inch.....$16.50

- ★ SPS ports with orifice up to .2 sq. in.
- ★ Ports interchangeable for supply or exhaust.
- ★ Standard O-ring seals, silicone lubricated
- ★ Constant duty AC solenoids with optional cover. (Inrush 4 amps. holding, 25 watts at 115 volts)
- ★ Illustrated valve 8" long, weighs 2 lbs, and mounts in any position. Many other models in stock.

Write for our Bulletin M-7 or order direct with our guarantee of satisfaction.

JOHN D. BACHMAN & COMPANY
1713 SPARGER LANE BRISTOL, TENNESSEE

Circle 42 on Reader Service Card

Circle 16 on Reader Service Card

pins, bushings and pitch holes in sidebars assures close fit of joint parts.

Specifications: Chains are available straight or with offset sidebars, with small or large rollers to cover a wide variety of power transmission applications. Nineteen sizes of offset-sidebar chains are available, ranging in pitch from 1.5 to 5 inches, with ultimate strength ranges from 8,000 to 280,000 pounds. Both types operate on standard wheels and a variety of attachments are available.

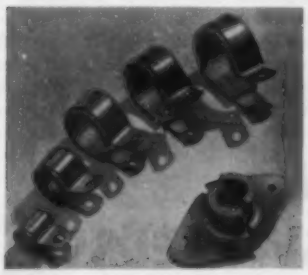
Link-Belt Company
Chicago, Ill.

Circle 158 on Reader Service Card

HYDRAULIC TUBE CLAMPS
. . . withstand extreme temperatures

Designation: Joclamp

Features: Clamps withstand temperatures ranging from —300 to 500 F and are serviceable for conditions at high altitudes as well as



jet engine heats. Clamp lining is molded-asbestos, wire-reinforced strip, impregnated with Teflon. Clamps are impervious to hydraulic fluids, lubricating oils, corrosive fuels and solvents. The new material has a very low coefficient of friction as well as a high degree of resiliency.

Joclin Manufacturing Company
North Haven, Conn.

Circle 159 on Reader Service Card

RING SEALS
. . . made in large diameters

Designation: Quad-Ring

Features: Rings from 21 inch diameter up can now be produced by a new method, which also provides for maintenance of normal, close cross-sectional tolerances. As in the smaller sizes, these large rings are designed with no parting line on sealing edges and eliminate spiral twist, rolling with pulsating pressures, and leakage at low pressure differentials. They should be effective for reciprocating, rotary and static uses. Standard cross-sections are: .070, .103, .139, .210 and .275 inches.

Minnesota Rubber & Gasket Company
Minneapolis, Minn.

Circle 160 on Reader Service Card

ELECTRIC MOTOR
. . . offers direct mounting

Designation: Type J

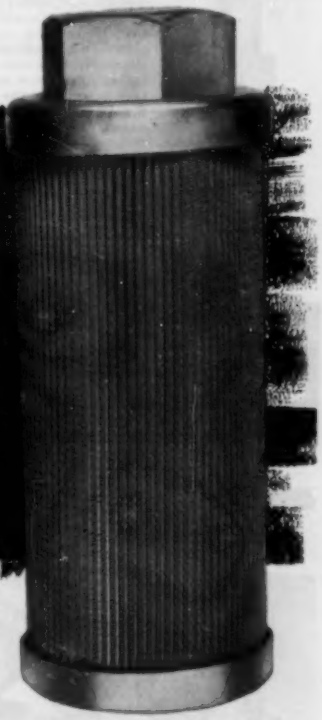
Features: Motor is totally-enclosed, with facilities for mounting the

Continued on next page

Capital

HYDRAULIC OIL FILTER with Monel Metal Insert

Reservoir Type for Hydraulic and Oil Re-circulating Machinery



EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS

★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle 24 on Reader Service Card

Circle 109 on Reader Service Card

Sonnet's NEW Port Contour Cutter Produces the NEW S.A.E. Standard Hydraulic Boss IN ONE PASS!

Cuts job time ⅔! This new special-purpose cutter has four flutes, with opposite flutes designed to perform the complete operation. A single pass of the cutter completes the chamfering, counterboring, radiusing, countersinking and spot facing operations necessary to produce the new S.A.E. straight tube hydraulic port boss. As a result, time required to complete the job is cut approximately ⅔!

Made from alloy-steel, the new tool is hardened for toughness and carbide tipped for long cutting life and smooth finish.

Write for sizes and prices today

Sonnet TOOL AND MFG. CO.

576 No. Prairie Avenue, Hawthorne, California

Precision cutting tools in high speed steel and carbide

New Products continued

driven equipment directly to the motor. Accurate alignment is provided by means of a totally-enclosed, NEMA style C bracket, with tapped holes for bolting from the driven equipment side. Motor has more horsepower in less space.

Specifications: Unit is shock resistant and cast iron frame is heavily ribbed for strength and heat dissipation. Guarded fan propels air over the frame ribs for cooling and self-cleaning. Brass slinger keeps moisture out of the take-off shaft. Rotor is electronically balanced. The direct connecting feature is also available in Type E, certified-safe, explosion-proof models in Class I, Group D, protected against inflammable gases and volatile liquids; and Class II, Groups F and G, for operation in combustible dust atmosphere. Ratings are 1 to 30 hp.

U. S. Electrical Motors, Inc.
Los Angeles, Calif.

Circle 161 on Reader Service Card

PILOT VALVE
. . . gives close control

Designation: No. 811

Features: Designed for use with diaphragm-actuated, regulating valves, the unit responds to small variations in controlled pressures in the flow line, and readjusts the main regulator for precise throttling of air or oil flow. Action is positive, and pilot accurately positions diaphragm valves used either as reducing valves or unloading valves. Valve eliminates wasting of hydrau-

A 5-STAR LINE!

★ ★ ★ ★ ★

★Model 1AM ★Model 2AM ★Model 4AM ★Model 6AM ★Model 8AM

GAST ROTARY VANE AIR MOTORS

are explosion-proof, variable in speed, low in cost!

Connected to any compressed air line, Gast Air Motors offer you:

1. Explosion-proof power. No danger!
2. Low initial cost per rated h.p.
3. Variable-speed with valve control.
4. Can't burn out from overloads.
5. Vanes take up their own wear.
6. Reversible rotation optional on Models 4AM and 8AM.
7. Very compact—light in weight.
8. Top-quality ball-bearing design.

Write for Bulletins—specify models!

Gast Manufacturing Corp., P.O. Box 117-D, Benton Harbor, Mich.

PERFORMANCE TABLE				
Model No.	R.P.M.	HORSE POWER at 60 P.S.I.	HORSE POWER at 90 P.S.I.	Wt. Lbs.
1 AM	2,000 3,000	0.11 0.21	0.13 0.30	1½
2 AM	1,000 2,000	0.22 0.40	0.35 0.57	5¼
4 AM	1,000 2,000	0.48 0.78	0.73 1.10	7½
6 AM	500 2,000	0.40 1.30	0.65 2.00	18
8 AM	500 1,500	1.00 2.30	1.45 3.80	25

Original Equipment Manufacturers for Over 25 Years

GAST ROTARY
- AIR MOTORS TO 4 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

See Our Catalog in Sweet's Product Design File

Circle 44 on Reader Service Card

TEFLON HOSE SWIVELS

Mayson Hose Swivels with stainless bodies and Teflon packings are handling a long list of chemicals and gases without lubrication.

Mayson's exclusive controlled pressure drop mounting of packings permits much higher pressure-velocity ratings.

½" and ¾" pipe size Teflon swivels are now in production.

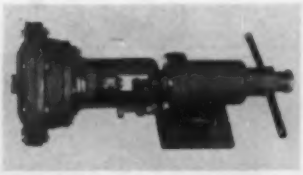
MAYSON MFG. CO.

4332 HORATIO STREET • DETROIT 10, MICH.

Circle 76 on Reader Service Card

lic fluid while retaining very sensitive control of the diaphragm valve. Unit consists of a two-way valve actuated by a diaphragm opposed by a loading spring.

Specifications: Controlled pressure ranges are: 3-15, 10-40 and 25-100 psi. Minimum operating pressure of 30 psi is required. Valve is



fitted with pressure gauges to indicate the inlet hydraulic pressure and the load line pressure to the diaphragm valve.

Atlas Valve Co.
Newark, N. J.

Circle 162 on Reader Service Card

CHECK VALVE
. . . features light weight

Designation: Series 1800

Features: Designed for aircraft applications, the units are made from high strength, aluminum alloy, and feature a 55 percent weight saving over conventional steel check valves.

Specifications: Approved as MS-28890-8, the valve shown is one of seven sizes in the series of heavy-duty, cone-type check valves. Units have a rated flow capacity from 1.2 to 29.0 gpm, and an ambient

temperature range from —65 to 160 F. Wider temperature ranges are available on special order. Sizes 1/2, 5/8, 3/4 and 1-inch OD are made from aluminum; 1/4, 5/16 and 3/8 inch are made from steel.

Tactair Valve Division
Aircraft Products Co.
Bridgeport, Pa.

Circle 163 on Reader Service Card

VANE PUMPS
. . . offer high efficiency

Designation: T Series

Features: Hydraulically balanced vanes and rotors reduce wear on cam rings and thrust plates for long life with less maintenance. Pump may be face, flange, or bracket

Continued on page 136

Moisture Can Mean Trouble

In compressed air lines, moisture is a menace. Eliminating oil and moisture with Heat-X aftercoolers and moisture separators provides low cost insurance against receiver tank explosions, rusting and corroding of pipe lines, fouling of air instruments and freezing of water in pipelines and air tools. Units are easily installed on existing systems.

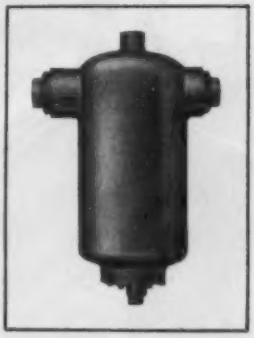
'WIA' AFTERCOOLERS

Cover the range from 100 to 1,000 C.F.M. Longitudinal Inner-Fin construction, *exclusive with Heat-X,* provides maximum heat transfer with minimum air side pressure drop . . . permits use of a more compact model. Units cool compressed air to within 10° F of temperature of available cooling water . . . use minimum amount of water.

heat-x

'RIA' REFRIGERATED AFTERCOOLERS

For use on systems where extremely dry air is required. Flooded refrigerant side operation, air flow through patented Inner-Fins, makes possible an extremely compact unit. Short length of tubings means low air side pressure drop and a rugged unit with no floating tube sheet. All copper and brass for corrosion resistance and long life. All welded construction.



MOISTURE SEPARATORS

These simple, rugged units separate water and oil that condenses in aftercooler . . . prevent passage of foreign particles into system. Available in capacities from 150 C.F.M. to 1,000 C.F.M.

Bulletins containing complete specifications FREE on request

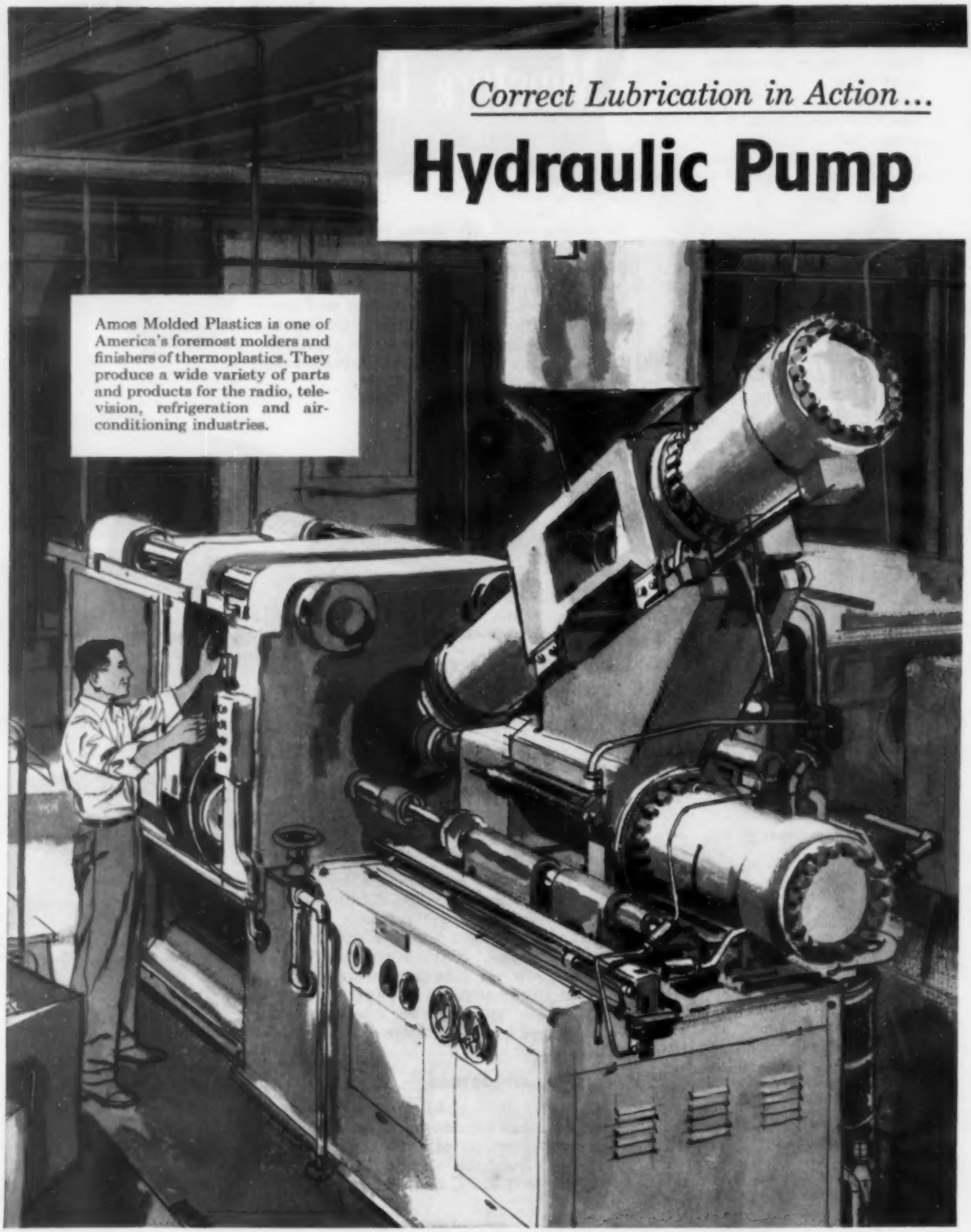
HEAT-X, Inc.
BREWSTER • NEW YORK

Circle 52 on Reader Service Card

Correct Lubrication in Action...

Hydraulic Pump

Amos Molded Plastics is one of America's foremost molders and finishers of thermoplastics. They produce a wide variety of parts and products for the radio, television, refrigeration and air-conditioning industries.



Mobil **SOCONY MOBIL**

Leader in lubrication for over 91 years

in the **Plastics Industry**

Maintenance Cost Cut 44%

One of many maintenance savings achieved for Amos Molded Plastics with the help of Socony Mobil

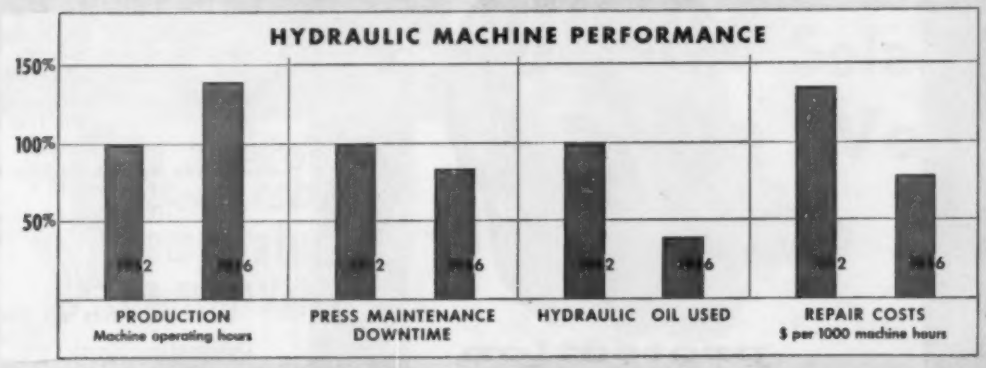
Despite a 37% increase in production hours over a five-year period, Amos Molded Plastics has managed to reduce maintenance and production costs consistently. This leading plastics manufacturer credits Socony Mobil's program of Correct Lubrication with a good share of these savings.

To illustrate: Records show that in 1952 molding machine hydraulic pump repair costs ran $135 per 1000 operating hours. Mobil engineers, working closely with the plant engineer, analyzed maintenance procedures . . suggested improvements. They helped set up lubrication schedules for each machine . . . recommended the correct Mobil product for all equipment. Today, in spite of higher labor and parts costs, repair expenditures have been cut to $76 per 1000 operating hours . . . a reduction of 44%.

This is Correct Lubrication in Action—the only program that gives you the benefit of 91 years of lubrication knowledge . . . the services of more experienced lubrication engineers . . . top-quality products. It cut costs for Amos Plastics. Why not for you?

How Correct Lubrication Cuts Maintenance Costs

Graph shown here gives an accurate picture of results achieved for Amos Plastics through Mobil Correct Lubrication. Some ways this remarkable record was accomplished are detailed below.



Machine downtime cut — Excessive downtime of molding machines was found to be due to oil leakage and oil contamination. Mobil engineers recommended improved oil seals . . . set up periodic laboratory analyses . . . proposed annual cleaning of hydraulic systems. This cut downtime 17% . . . saved $13,800 over 1952 figures.

Oil consumption cut sharply—Socony Mobil maintenance clinic., conducted for plant's hydraulic engineers, taught them latest methods of reducing leakage. In addition, because Mobil hydraulic oils are of top quality they can be reprocessed and used indefinitely. Result—oil use was reduced 63% . . . $4,600 saved yearly.

These savings and many more helped Amos Molded Plastics increase profits. For information on how Mobil Correct Lubrication can cut costs, improve production, contact your Mobil representative.

Correct Lubrication

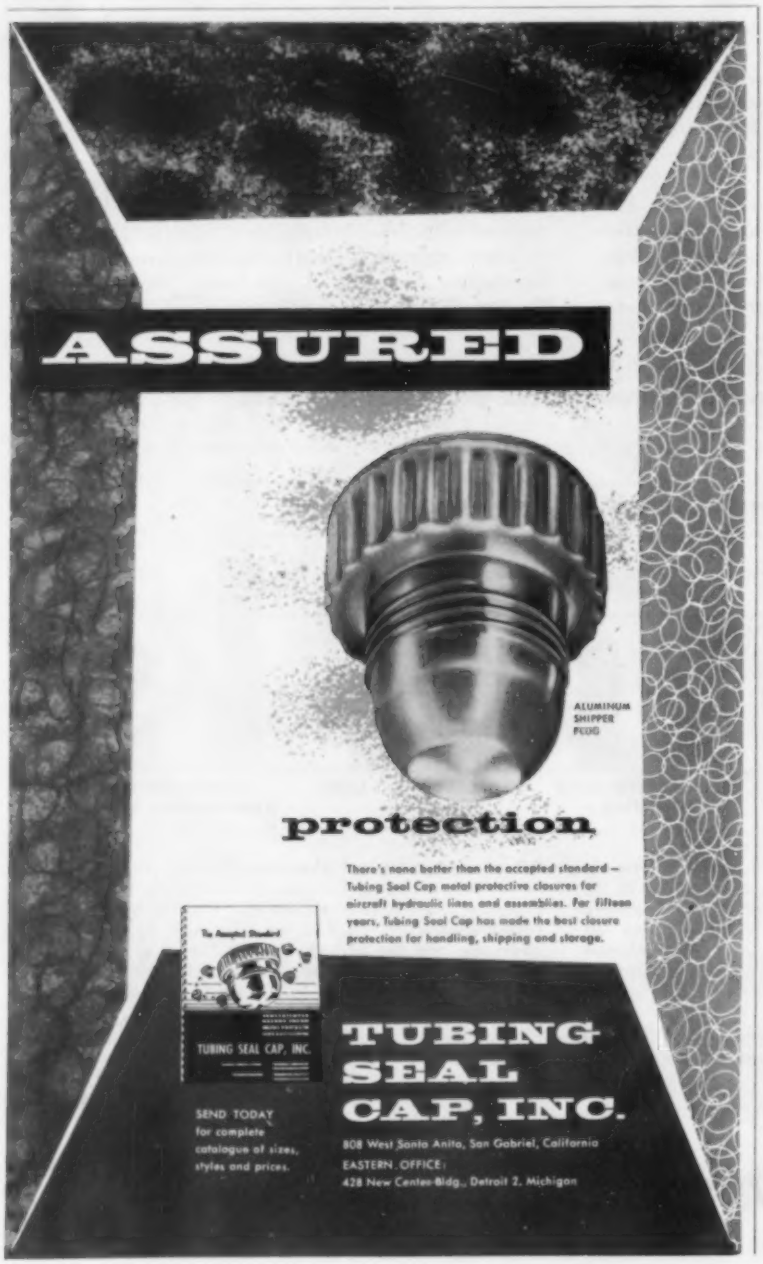
A proved program to reduce maintenance costs

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

New Products continued

mounted. Inlet port can be assembled in different positions relative to the pressure port. Unit starts in any weather conditions and operates clockwise or counter-clockwise.

Design: Pump consists of a housing which provides an outlet connection, a bore for support of shaft bearing and shaft assembly, and a larger bore containing the floating pumping cartridge. This is made up of front port plate, vane, rotor and cam ring assembly, and rear port plate with a shaft end support bearing. Port plates are part of the pumping cartridge.


ASSURED
protection
There's none better than the accepted standard — Tubing Seal Cap metal protective closures for aircraft hydraulic lines and assemblies. For fifteen years, Tubing Seal Cap has made the best closure protection for handling, shipping and storage.
TUBING SEAL CAP, INC.
SEND TODAY for complete catalogue of sizes, styles and prices.
TUBING SEAL CAP, INC.
808 West Santa Anita, San Gabriel, California
EASTERN OFFICE:
428 New Center Bldg., Detroit 2, Michigan

Specifications: Designed for service at 2000 psi, delivering 100 gpm at 1800 rpm. Nose-type shaft seal

withstands pressures up to 1000 psig. Shaft rotation easily changed by indexing the cam ring.

Denison Engineering Div.
American Brake Shoe Co.
Columbus, O.

Circle 164 on Reader Service Card

SILICONE RUBBER PACKING . . . resists aging

Features: Material resists aging, sunlight and ozone and has a low compression set. Silicone rubber withstands temperatures up to 300 F and is flexible at —70 F. Special material remains flexible at —120

F. Along with good dielectric strength, silicone rubbers will not stick to metal at high temperatures and will not corrode adjacent metal parts. A complete selection of packing materials is available.

The Garlock Packing Co.
Palmyra, N. Y.

Circle 165 on Reader Service Card

NIPPLE CHUCK . . . fits all threaders

Designation: Speed-Thru

Features: Pipe and conduit nipples of any length can be made on the job by hand-threading or power drive with this nipple chuck. Tool fits all threaders adjustable to 2 inches.

Specifications: Chuck is precision machined, with all wearing parts made of hardened steel. Unit comes packed in a heavy-gage metal tool box with holding adapters from

Continued on page 138

Circle 7 on Reader Service Card

3000 psi won't get by the threads of Allen ○ Dryseals!

ALLEN 'TRU-ROUND' Dryseal Pipe Plugs

formed from special analysis ALLENOY steels.

Sold only through leading industrial distributors—specify genuine Allen Dryseal Pipe Plugs.

standard sizes from 1/16" to 1-1/4"

Here's the dependable, metal-to-metal seal you need for hydraulic systems . . . for transmission, control, and automated mechanisms where pressures run high. The N.P.T.F. threads of Allen ○ Dryseal Pipe Plugs are smooth, burnished, and burr-free — do their job without any help from sealing compounds. Allen's unique "pressur-forming" process assures the highest degree of precision threading and dimensional accuracy. What's more, Allen ○ Dryseals are precisely round at root, pitch and crest, with taper held to extremely close tolerances.

Allen engineers will gladly help you to harness your hydraulic pressures. Just write.

ALLEN
MANUFACTURING COMPANY
Hartford 2, Connecticut, U. S. A.

ACCURATE TEMPERATURE CONTROL

Sterlco® Series 150-E Temperature Control Valve

gives you QUALITY CONSTRUCTION • • • DEPENDABLE PERFORMANCE

at a LOW COST It is a self-actuated, completely automatic modulating control valve — for any heating or cooling application using steam, water, or other heat transfer fluids. Available in ½", ¾", and 1" sizes and for temperatures up to 255 degrees F. . . . and, remember, the Sterlco Series 150-E . . .

MOUNTS AND OPERATES IN ANY POSITION

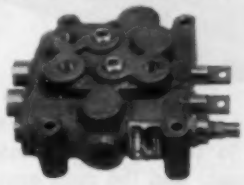
Send for BULLETIN #505 INDUSTRIAL CONTROL DIV.

STERLING, INC.
3742 N. Holton St., Milwaukee 12, Wis.

HUSCO HYDRAULIC UNITS

Primarily Engineered for Construction and Materials Handling Equipment, HUSCO Hydraulic Units are preferred for Their Space-Saving, Positive Operational Control and Cost-Saving Efficiency.

HUSCO HYDRAULIC CONTROL VALVES

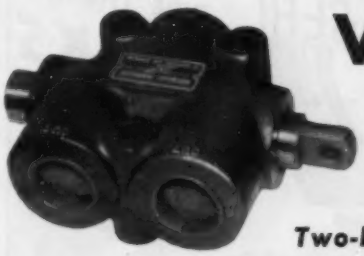


Here is new engineered compactness in multiple-purpose valves that offer many advantages. Available in a full range of sizes with capacities from 6 to 60 G.P.M., in single-acting, double-acting and float position operational control, with from one to four cast-on-bloc plunger arrangements. Designed with fine throttling control in operating positions, they provide built-in adjustable relief valves and built-in check valves in operating circuit, and assure practically unrestricted flow through the valve. Available in either Series or Parallel circuits, with or without High Pressure Carry-over.

HUSCO ROTARY SWIVEL

Low cost, highly efficient Rotary Swivel designed for both high pressure and high operating speeds, particularly in the brake and clutch field. Compact, for use in close quarters. Has spring-loaded Teflon rings, self-centering ball thrust bearing, highly efficient axial bearings. Size, only 3" x 1½".

NEW HUSCO Selector Valves



Provide accurate control of Two-Line Sequence

These new precision-machined selector valves, unusually compact and space-saving, provide instantaneous adjustment for either of the fluid lines. Important addition to the HUSCO line of hydraulic valves, cylinders, pumps and controls, the new Series 3070 Selector Valves are available in two sizes—for capacities up to 30 and 60 g.p.m.

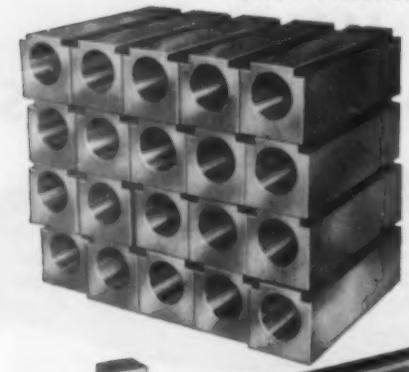
Write for engineering specifications on the new HUSCO Series 3070 Selector Valves, and suggestions on their profitable adaptation on your equipment.

Check HUSCO first for modern hydraulic units engineered to your needs.

HUSCO

HYDRAULIC UNIT SPECIALTIES CO.
PUMPS • VALVES • CYLINDERS
WAUKESHA, WISCONSIN

Circle 9 on Reader Service Card



Hydraulic CYLINDERS to specification

AT your service — since 1918 — the most modern machine tools to handle up to 15" I. D., including the last word in honing equipment and the most accurate of precision gauging equipment. Everything we do is to specification. Expanded facilities permit prompt delivery of 1 or 1000 pieces in any material desired.

Call Erie 2-3664 - Send specifications to

AMERICAN HOLLOW BORING COMPANY

1954 Raspberry St., Erie, Pa.

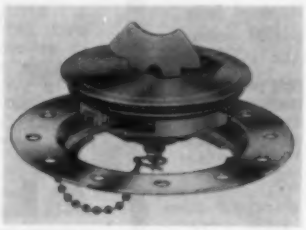
New Products continued

1/2 to 1-1/2 in. diam. Two-inch diameter nipples thread into the chuck body for holding. 1/8, 1/4 and 3/8-in. adapter bushings are optional. Overall length of the chuck is less than 10 inches. Also available with adaptors for British Standard Pipe Thread.

Mercury Hydraulics, Inc.
Denver, Colorado

Circle 166 on Reader Service Card

OIL RESERVOIR CAP . . . has lever action



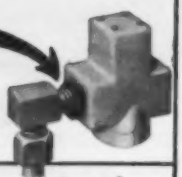
Designation: FC-3500

Features: Cap has a full 3-in. opening, and may be opened and closed

TRU-O-SEAL TEFLON SEAL

STOPS PIPE THREAD LEAKS

PAT. PENDING



Satisfaction Guaranteed Or Money Back TRIAL OFFER

TRU-O-SEAL Fittings are guaranteed to seal pipe thread connections permanently against all oils, practically all known chemicals and gases; to seal under high pressures or vacuum; to withstand —280° to plus 500° F.; to eliminate "overtightening" damage and pipe dope. Available in ⅛" to 2½" pipe thread sizes.

$10.00 Trial Offer No. 1: eight ⅛", ten ¼", eight ⅜", ten ½" pipe thread TRU-O-SEAL Fittings.

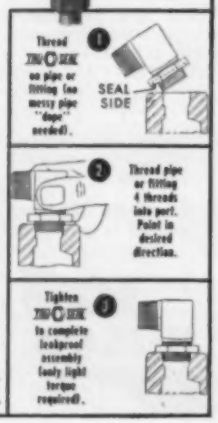
$10.00 Trial Offer No. 2: eight ½", ten ¾", four 1" pipe thread TRU-O-SEAL Fittings.

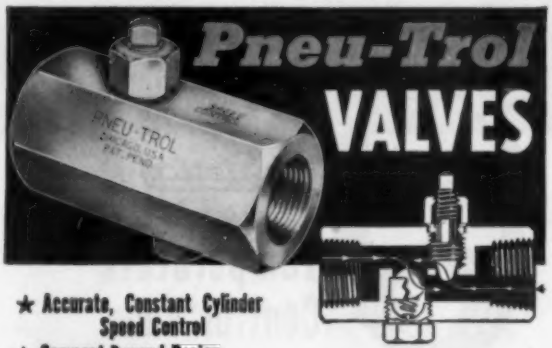
Send order to

TRU-O-SEAL DIVISION Flick-Reedy Corporation

2008 N. Hawthorne • Melrose Park, Ill.

"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.


1
Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed).
SEAL SIDE
2
Thread pipe or fitting 4 threads into port. Point in desired direction.
3
Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).



★ Accurate, Constant Cylinder Speed Control
★ Compact Rugged Design
★ Simple, Easy Speed Selection ★ For Air, Oil or Water Applications

Pneu-Trol Speed Control Valves are widely used in hundreds of control applications because they combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to its seat, requiring only a slight differential pressure to fully open or close it.

Needle design permits maximum flow capacity in the controlled direction. Metal to metal needle and ball seats insure long trouble-free service. Simple, practical "O" gland structure eliminates troublesome leaking. Valve bodies machined from hex brass or aluminum for 2000 psi working pressures; steel and stainless steel for 5000 psi. Made in 5 female pipe sizes—⅛" to ¾". ATTRACTIVE PRICES . . . IMMEDIATE DELIVERY.

Write for illustrated circular and prices.

Pneu-Trol DEVICES, INC.

1426 N. KEATING AVENUE • CHICAGO 51, ILL.

Circle 120 on Reader Service Card

Circle 92 on Reader Service Card

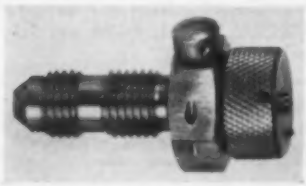
by means of a lever action that automatically relieves any pressure in the tank before the cap is unlocked. **Specifications:** A 35-degree turn will remove the cap. Unit weighs only 0.43 lb and permits quick maintenance with standard O-rings readily changed when necessary. Available in 1.5, 2.3, and 3.82 inch openings.

Gabb Special Products, Inc.
Windsor Locks, Conn.

Circle 167 on Reader Service Card

BLEEDER VALVES . . . are semi-automatic

Features: Units permit bleeding with a twist to open. When released, cap closes with practically zero leakage. Valve is fast, clean, safe, precision made, and tested to conform to MIL-V-5528. Applications include bleeding air from filter housings and reservoirs, and high points in hydraulic systems.



Specifications: Push-button type, semi-automatic bleed and drain valve is available. Operating pressure range is up to 5000 psi, temperature to 275 F. Available in aluminum or stainless steel, and with various end fittings.

Arkwin Industries, Inc.
Westbury, N. Y.

Circle 168 on Reader Service Card

PUMP PACKING . . . resists chemicals

Designation: 403

Application: Material has shown excellent results in cases where pure Teflon has failed. It is serviceable from —150 to 500 F for applications requiring the chemical resistance qualities of this packing. Material has been successfully used on valves, pumps and other components.

Features: Packing is composed of shredded Teflon, combined with suitable binders and lubricants, extruded in an open cotton yarn jacket, impregnated with graphite. It it also available in bulk form for packing multi-size fittings, and where rapid assembly prohibits use

Continued on next page

For pressures to 5,000 psi
STRATOFLEX
HOSE and FITTINGS
meet your specs
When you design with Stratoflex you get more than the vibration and stress resistance inherent in flexible hose. You get hose fittings designed to meet your specific requirements. Stratoflex hose and fittings are available in a wide range of types and sizes . . . lightweight for aircraft use . . . corrosion resistant for marine applications . . . Teflon* for extremely high or low temperatures . . . heavy duty, double-wire braid types for high pressure. Stratoflex leak-proof, reusable fittings make possible quick, easy replacement or modification. You simplify both design and maintenance when you specify Stratoflex.
*TEFLON is a registered DuPont trademark.
TYPICAL ASSEMBLIES
SF 212 DOUBLE WIRE BRAID HOSE with SF 320 REUSABLE SWIVEL FITTING for high pressure applications. Working pressure range: 1,125 to 5,000 psi.
SF 211 SINGLE WIRE BRAID HOSE with SF 319 REUSABLE SWIVEL FITTING for medium pressure applications. Working pressure range: 350 to 2,000 psi.
SF 124 TEFLON HOSE with SF 534 SWAGED FITTING for aircraft applications. Stays flexible from —100° to +450° F. Unaffected by all fuels, petroleum, synthetic base lubricants, acids, and solvents.
CALL YOUR INDUSTRIAL SUPPLY STORE OR WRITE FOR COMPLETE CATALOG.
STRATOFLEX Inc.
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Atlanta
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Kansas City
Los Angeles
San Francisco
Seattle, Toronto
Tulsa
Circle 114 on Reader Service Card

New Products continued

of braided or extruded type material.

Specifications: Available in 1/4 to 3/4-in. sizes on 10 and 20 ft. spools. Bulk form in one pound cans.

Abbott & Biddle
Philadelphia, Pa.

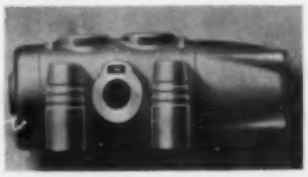
Circle 169 on Reader Service Card

FOUR-WAY VALVE
. . . is oil pressure operated

Designation: Model 5835

Features: This hydraulic four-way valve is oil pressure operated by an oil pilot valve, permitting automatic operation when the oil pilot valve is controlled mechanically. Unit requires oil pilot lines to each end of valve for remote operation from a pilot valve. Ball detents hold valve piston in either end position after pilot pressure has been removed.

Design: Unit has floating piston design, with valve stem independent of the valve bore, giving piston a precise fit. Stem is supported in its bearings in the covers without influence on the piston fit. Simple design provides leakproof operation and smooth, positive opening and closing. Large passages provide unrestricted flow.



Specifications: Designed for 1500 psi, units are offered in 7 sizes; 1/4, 3/8, 1/2, 3/4, 1, 1-1/4 and 1-1/2 inches.

Rivett, Inc.
Boston, Mass.

Circle 170 on Reader Service Card

TRADE MARK
Pan-Sec

A New Concept in Hydraulic Panels...

'Pan-Sec' sections bolt together easily—quickly—to make a complete hydraulic panel and Eliminates Costly Boiler Mounting Plates and Sub-Plates

only 'Pan-Sec' sections give you all these advantages

- **FLEXIBILITY** Sections can be easily added to or removed from your master panel by you at any time.
- **PRECISION MACHINED** Each section is machined to permit easy interchanging *AND* for the addition of sections to your master panel.
- **SAVES TIME** 'PAN-SEC' sections can be assembled into a master panel and piped ready for installation of valves *BEFORE* valves are delivered!
- **ECONOMICAL** Saves you money—No additional machining or engineering time required —No custom boiler plate or sub-plates needed.

PATENT PENDING

'Pan-Sec' sections can be assembled into ANY size hydraulic panel in multiples of 6". Shown front view of a master panel.

'Pan-Sec' standardized sections are engineered and designed for use with *ANY* J.I.C. standard gasket mounted hydraulic or air valve.

They are carried in stock ready for immediate shipment . . . can be used as individual units or bolted together to form a master panel. Valves mount directly on 'Pan-Sec' sections.

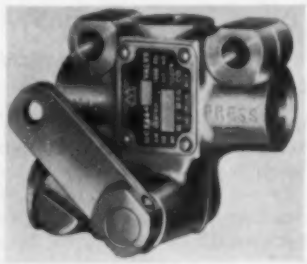
Write today
for our 'Pan-Sec' brochure . . . Gives complete information, plus how 'Pan-Sec' can be used with manifolds.
Representatives in all principal areas.

BIRMINGHAM
Hydraulic Products Co.
14540 Schaefer Road, Detroit, Mich.
Telephone BRoadway 3-8047

THREE-WAY AIR VALVE
. . . has wide range

Designation: MC-2664

Features: Designed for use with air or nitrogen, the valve features a wide operating temperature and pressure range, with minimum internal leakage. With pressure port connected to cylinder port, and 500 to 3000 psi at pressure port, the internal leakage is less than one bubble in two minutes.



Specifications: Unit is compact and weighs only 0.28 lb. Port connections are for 1/4-in. tubing. Ambient temperature range is —65 to 225 F. Operating pressure is 3000 psi and burst pressure is 7500 psi.

M. C. Manufacturing Company
Lake Orion, Michigan

Circle 171 on Reader Service Card

Circle 5 on Reader Service Card

it's NEW!

5/8 INCH BORE

AIR-OIL CYLINDER

If you've been using 1" or larger bore cylinders for those applications in which you wanted the "smallest" bore, here are some of the benefits you'll derive from the new AIROYAL ⅝" bore cylinder: more compact size; reduced thrust from a given pressure; lower piston and rod inertia; increased velocity from a given flow input.

Cylinders are available single and double acting in all mounting styles. And you'll appreciate the low price—only $28.00 list for pressures to 750 PSI, $32.00 for pressures to 1500 PSI.

MANUFACTURED BY

THE AIROYAL CO

1990 SPRINGFIELD AVENUE
MAPLEWOOD, N. J.
REPRESENTATIVES IN PRINCIPAL CITIES

THERE IS NO SUBSTITUTE FOR LONG-LASTING....

● Only *Plastic Lead Seal assures you a seal that will last as long as the connection itself. It is ideal for water, oil, gas, steam, refrigerants, chemicals and petroleum products at temperatures as high as 500°F., pressures to 6000 psi.

Because PLS remains plastic at all times, it gives permament assurance against leakers—regardless of vibration, expansion or contraction—yet permits easy disassembly of connections, even after years of service.

It's economical to use PLS on pipe joints, plugs, screwed fittings, flanges and gaskets—because it takes less to make a perfect seal.

PLS is easy to apply . . . and it's easy to try! Just send for a free sample.

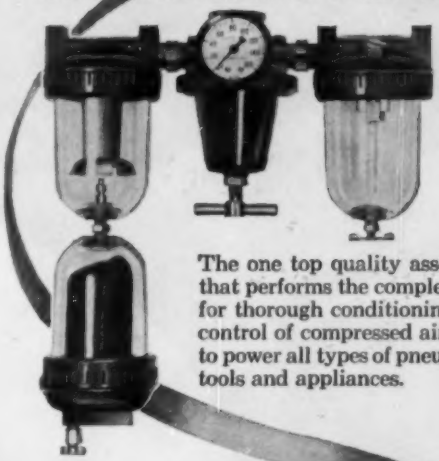
Available in 1-lb. cans (brush top or friction), 4-oz. plastic tubes, 5-lb. cans, 15 and 28-lb. pails and 85-lb. drums.

6405 Oakton Street, Morton Grove, Illinois, (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

CRANE PACKING COMPANY

ARROW

AUTOPNEUMATIC CONTROL

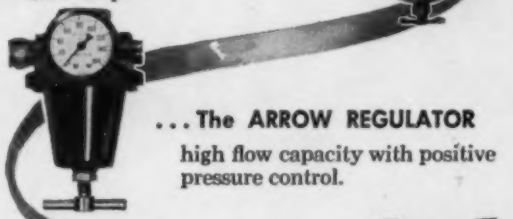


The one top quality assembly that performs the complete job for thorough conditioning and control of compressed air used to power all types of pneumatic tools and appliances.

The AUTOPNEUMATIC CONTROL ASSEMBLY features . . .

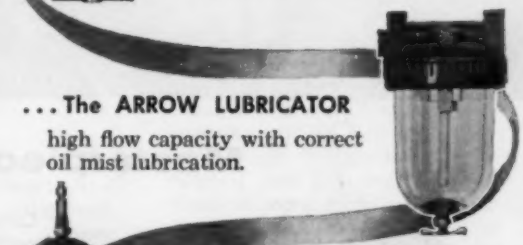
. . . The ARROW FILTER

high flow capacity with filtration as required and low pressure drop.



. . . The ARROW REGULATOR

high flow capacity with positive pressure control.



. . . The ARROW LUBRICATOR

high flow capacity with correct oil mist lubrication.

. . . The ARROW AQUAMATIC DRAIN TRAP

automatically disposes of collected moisture from filter with no loss of compressed air.

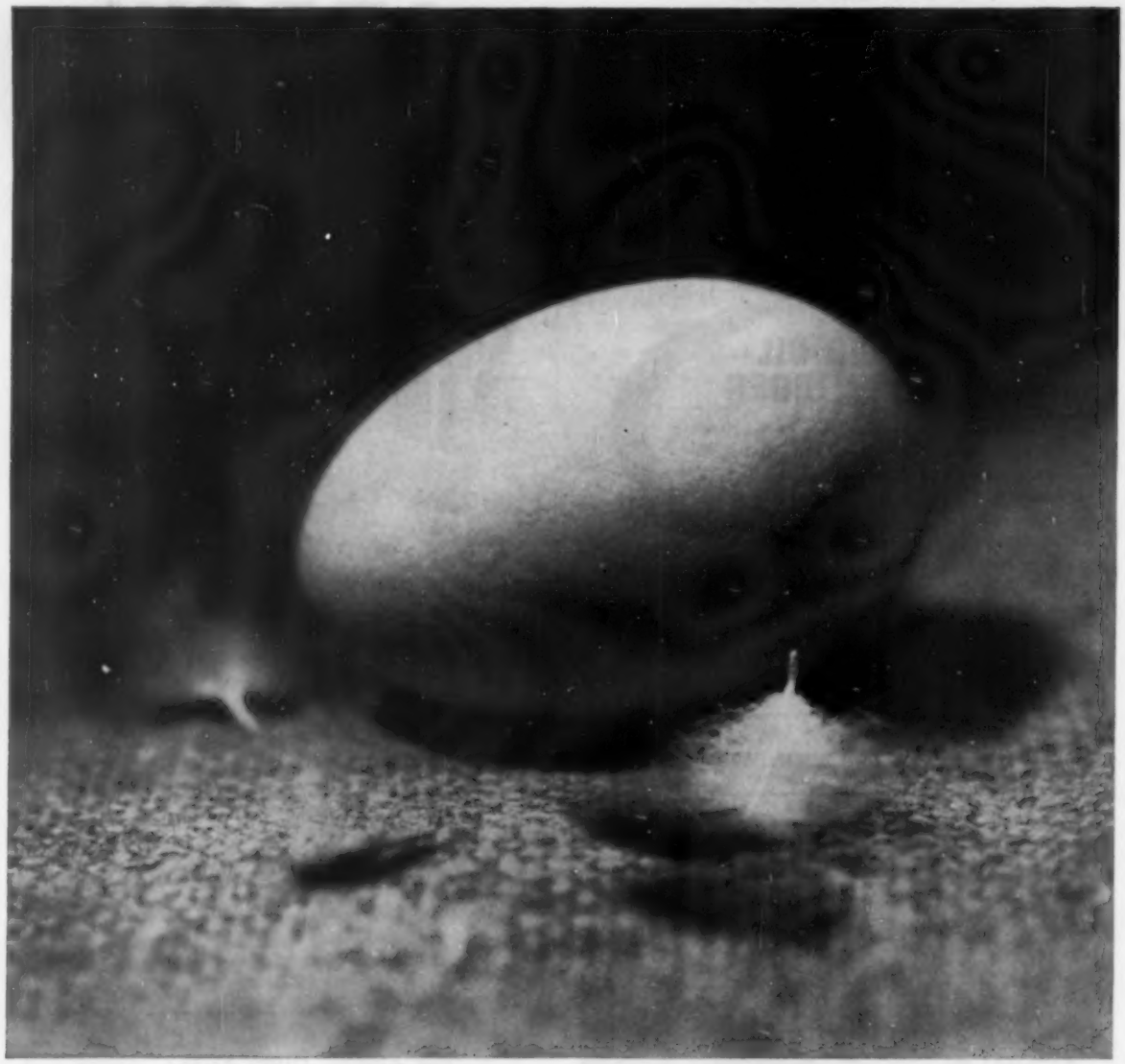
Assemblies and separate units supplied in pipe line sizes from ¼" NPT through 2" NPT.

QUALITY PRODUCTS SINCE 1914

Catalog and engineering data on request.

ARROW TOOLS, INC.

1902 S. KOSTNER AVE. • CHICAGO 23, ILL.



Masterpiece of simplicity

Consider the egg. Unique in shape, clean of line, its design is functionally perfect.

Much the same can be said of a MAC valve. Trim and compact, its simplified design meets the severe demands of our toughest customer. We engineered it to deliver the speed and stamina required by resistance-welding equipment . . . and knew this basic design would pay off handsomely in performance on less exacting jobs, too. That's why *all* MAC valves are built to these same rugged design specifications.

And that's why you can expect *more* from MAC—in efficiency and dependability, in longer life. Get proof. Contact a representative listed at right or send for the facts.

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park, Detroit 37, Michigan

MAC

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OAKLAND 8—The Rucker Co., 4700 San Pablo Ave., OLympic 3-5221
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DENVER 16—Blair Engineering Co., 4100 Grape St., FLorida 5-7142

FLORIDA
MIAMI SPRINGS—Aero Hardware & Supply Co., 4301 Northwest 36th St., TUxedo 8-2414

ILLINOIS
CHICAGO 43—Mike C. Modrich Co., 10918 South Western Ave., Hilltop 5-3640

INDIANA
FORT WAYNE 3—Neff Engineering Co., P.O. Box 2001, Station A, 2339 Crescent Ave., EAstbrook 7391
INDIANAPOLIS 20—Neff Engineering Co., P.O. Box 7361, 42nd St. Station, CLifford 5-5418
SOUTH BEND—Dick Futter, 103 South Varsity Dr., CEntral 2-3800

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FLINT—Kober Sales Engineering Co., 1115 Root St., CEdar 2-7165
WESTERN MICHIGAN—Everett Adams, 17212 Sharon Road, Chesaning, Michigan, Chesaning 383-J-1

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MISSOURI
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BUFFALO 25—C. H. Topas Co., 200 Washington Hwy., CIrcle 3210

OHIO
CINCINNATI—The R. W. Nichols Co., Fidelity Federal Savings Bldg., 2087-9 Sherman Ave., Norwood, ELmhurst 1-2440
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TOLEDO 4—The R. W. Nichols Co., 510 Manhattan Building, CHerry 1-1447

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PITTSBURGH 22—The R. W. Nichols Co., 101 Investment Bldg., ATlantic 1-6050

TEXAS
DALLAS 19—Womack Machine Supply Co., Shea Rd. at 7150 Harry Hines, FLeetwood 7-3871

WASHINGTON
SEATTLE—The Rucker Co., 1000 4th Ave., South, MAin 2783

WISCONSIN
MILWAUKEE 17—Neff Engineering Co., 5856 N. Pt. Washington Rd., EDgewood 2-1579

MECHANICAL AIR CONTROLS, INC.
DETROIT 37, MICHIGAN
MAC

Useful Literature continued

HYDRAULIC PUMPS . . . manufactured by Spenborough Engineering Co. Ltd, are discussed in a brochure. Units covered include three models of hand pumps, operating at 2000 psi, with displacement per stroke of 0.5, 1.374 and 2.748 cu. in. Power pumps are rotary swash plate type with four to thirteen plungers, suitable for constant running at 1000 psi or for intermittent operation at 2000 psi.

Circle 210 on Reader Service Card

ROLLER CHAIN . . . produced by the Link-Belt Company is covered in Book 2454. Complete presentation is given of the features of LXS bushed roller chain, including balanced design for extra strength, increased wear resistance and wider application flexibility. The application and selection data should be of interest to engineers working on power transmission problems. These chains are manufactured in two designs, straight or offset sidebars, with small or large rollers to cover a wide variety of power transmission applications. Nineteen sizes of offset sidebar chains are available, ranging in pitch from 1.5 to 5 inches, with ultimate strength range from 8000 to 280,000 pounds. Both types operate on standard wheels and a variety of attachments are available.

Circle 211 on Reader Service Card

MOTOR CONTROLS . . . for every type of fluid power service are listed in 131-page catalog available from Allen-Bradley Co. Items covered include dc apparatus, drum switches, speed regulators, ac manual starters, ac magnetic starters, limit switches, accessories, synchronous starters.

Circle 212 on Reader Service Card

LEAKPROOF ADAPTER . . . featuring ring-wedge design for leakproof hydraulic connector application in standard female tapered pipe thread component ports, is described in catalog page released by Perch Mfg. Co. Design embodies a male pipe thread pitch cut on a straight shank, relieved by longitudinal slots to assume the female taper of the port, and at the same time provides a locknut type of action. An O-ring in the hex body of the fitting seals against the adjacent flat area surrounding the female port. This design gives straight-thread sealing without converting all existing hydraulic component ports.

Circle 213 on Reader Service Card

PLASTIC HOSE . . . for pneumatic or hydraulic service at pressures to 125 psi, is described in Bulletin H-52 published by Hofmann Engineering Co. Hose is made of vinyl plastic, with ID and OD held to very close tolerances. Complete engineering and technical data is given on the hose, fittings and adapters.

Circle 214 on Reader Service Card

AIR FILTERS . . . for pneumatic control systems are manufactured by Air-Maze Corp. Bulletin IAF-856 covers air filters designed to remove fine dirt particles and entrained liquid droplets from compressed air streams to assure dependable precision operation of pneumatic control systems requiring air to be micronically clean.

For instruments requiring relatively small quantities of extremely clean air, filters with special felt type filter media are used. Tests indicate efficiencies of over 95 percent on particle size down to 1 micron. When air temperature at the filter is over 200 degrees F, air filters of metal media type are recommended. These filters are of metal disc type and operate under higher temperatures with no change in performance characteristics. Metal disc construction also greatly extends filter area, providing initially low pressure drop and long service period before pressure drop builds up.

Circle 215 on Reader Service Card

O-RINGS . . . of Teflon, Kel-F and Nylon, are produced by Dodge-Wasmund, Inc. Line also includes specialized plastic seals, packings, gaskets and insulators for fluid power applications. Data sheets are

Continued on next page

Useful Literature continued

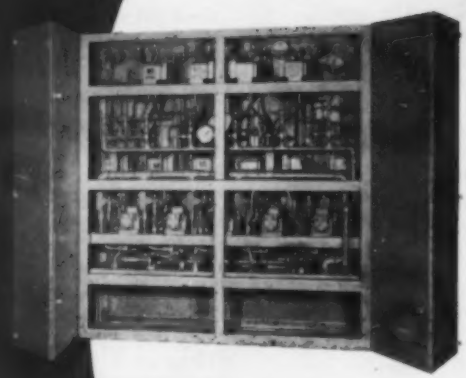
available giving complete engineering information on the various sizes.

Circle 216 on Reader Service Card

FLEXIBLE COUPLINGS . . . manufactured by American Flexible Coupling Division of Zurn Industries, Inc. are presented in their 12-page Catalog No. 501. Bulletin gives design information and specifications on their complete line of flexible couplings, and includes valuable information on the use of flexible couplings, types of misalignment and basic types of flexible couplings. The line includes special purpose units, and various types such as mill motor, shear pin or overload release, cut-out, vertical, extended, axially adjustable, brake drum, special traction, continuous lubricated, and continuous sleeve types. Tandem couplings, incorporating two single engagement couplings for use in compensating for large amounts of offset misalignment are also available. Standard coupling consists of three basic parts—two identical jaw flanges and a floating center member. Jaw flanges are positioned at right angles to each other and engage opposite parallel surfaces of the center member.

Circle 217 on Reader Service Card

HYDRAULIC ENGINEERING FOR INDUSTRY



Rear view showing interior of Cardwell custom hydraulic control panel for floor mounting. Furnished with double-fold access doors.

APPLICATION:
Steel mills, paper mills, or any centralized hydraulic system.

The CARDWELL MACHINE COMPANY
Franklin at 19th St., Richmond 11, Virginia • Phone 7-4593

HYDRAULIC POWER UNITS . . . providing low-cost power source for small and medium size hydraulically operated machinery, are built by The Weinman Pump and Supply Co. Bulletin gives dimensional information, discusses features of the units and illustrates a standard unit and several modifications.

Circle 218 on Reader Service Card

PILOT VALVES . . . for handling hydraulic fluids at high pressures and flow rates, are illustrated in catalog issued by Baldwin Instrument Company Ltd. Units are electro-magnetic, glandless poppet type, offering fast, powerful action and 100 percent sealing at all pressures. Operation of the valves is described and illustrated in detail.

Circle 219 on Reader Service Card

HYDRAULIC ACTUATORS . . . designed and built by Pegasus Laboratories, Inc., are described in Technical Bulletin 100. Line includes electro-mechanical and instrumented actuators, and electro-hydraulic servo valves.

Circle 220 on Reader Service Card

FILTER MAINTENANCE . . . for line and sump-type filters is covered briefly and clearly in a one-page bulletin issued by Marvel Engineering Co. Cross-sections of both types of filters are given, and maintenance procedures are given in step-by-step sketches.

Circle 221 on Reader Service Card

SOLENOID VALVES . . . for control of air or hydraulic fluid are de-

Continued on page 146

Circle 58 on Reader Service Card

"Wipe out" PACKING FAILURES WITH Seal-Guard METALLIC ROD WIPERS

Self-adjusting, easy to install, Seal-Guard's knife-like bronze rings "wipe off" all dirt and grime, will not mar the rod, are oil and heat resistant and friction-free.

HOW SEAL-GUARD WORKS

1. Twin wiper rings are mounted on rod with notches staggered.
2. Cushion ring is compressed on assembly exerting constant inward pressure keeping ring in constant contact with rod.
3. Harmful substances are completely cleared by scraper action.

Seal-Guards are available to fit rod diameters from ¼ to 24 inches. Other sizes by special order.

WRITE FOR DESCRIPTIVE LITERATURE.

HYDRAULIC ACCESSORIES CO.
24301 Hoover Rd. Van Dyke, Mich.

Circle 102 on Reader Service Card

PNEUMATICS SHEFFER HYDRAULICS

AIR CYLINDERS

C5 Series

- 200 psi Air—to 1000 psi Hydraulic
- All Steel Construction
- Meets or Exceeds J.I.C.
- 11 Bore Sizes—1½—14
- Removable Rod Cartridge
- Finest of the "Interchangeables"

Write for Bulletin #356

THE SHEFFER CORP.
CINCINNATI 16, OHIO
MOST COMPLETE LINE OF CYLINDERS IN THE INDUSTRY
SOME TERRITORIES OPEN

Announcing—

A NEW GRESEN VALVE
With FLOAT Position

GRESEN HYDRAULICS

A Two Spool Directional Control With Float

FEATURES: Detent in Float Position—Self Centering From Power Positions—Fully Balanced—Relief Valve Has Replaceable Hardened Seat—Tripod Mounting Feet—Smooth Positive Throttling Action—Hardened and Chrome Plated Spools.

SPECIFICATIONS: Capacity 20 GPM (at 20 Ft/seconds)—Maximum Pressure 1500 PSI—Parallel Application—Shipping Weight 22-1/2 Lbs.

Write for literature

GRESEN MANUFACTURING CO.
628 Colfax Ave. N. Dept. H-47 Minneapolis 11, Minn.

AIR-MITE
HIGH PRODUCTION AIR PRESS
with more Quality Features

★ Solid Steel Column. Greater strength and rigidity.
★ Brass cylinder, aluminum end castings, Hy-Car piston cups.
★ Accurately ground table.
★ Fast set-up and stroke adjustment.

You don't have to "baby" an AIR-MITE Press because they're ruggedly built to stand the gaff of production work. From the tip of their solid steel column to the heavy base, they're every inch a workhorse tool. Feature-for-feature, you can't buy a better, more economical operating press than an AIR-MITE.

Special adaptations available. Write us your needs.

1 Ton Capacity
$89.95
F.O.B. Chicago

New 3 Way Control Valve. For safer, more efficient press work, use AIR-MITE Control Valves. Connected in parallel and positioned on either side of an air press, they provide a safe, instantaneous press operating control. Operator must depress both handles to actuate press . . . keeps attention on work-piece, hands out of the way. For pressures up to 160 p.s.i.

AIR-MITE Devices, Inc.
4401 W. KINZIE ST., CHICAGO, ILLINOIS

Useful Literature continued

scribed in Bulletins 87 and 89 released by Magnatrol Valve Corp. Application, construction and operation of the various models is covered, along with illustrations and schematic drawings. Units are available in pipe sizes from ½ to 3-inches.

Circle 222 on Reader Service Card

AIR COMPRESSORS . . . requiring no oil for lubrication, thus producing oil-free air and reducing maintenance, are detailed in Bulletin GO-1156 released by Bell & Gossett Co. Units are designed with graphite piston rings and skirts and do not require oil separators.

Circle 223 on Reader Service Card

LENZ "O"-RING
NO METAL TO METAL SEAL
J.I.C. APPROVED
HELD BY FRICTION GRIP OF THESE TWO
NO CONCENTRATION OF STRESSES DUE TO FLARES OR FERRULES FOR TUBE FAILURE
NO EXACT TUBE LENGTH NECESSARY
NOT NECESSARY TO CUT TUBE SQUARE
SEAL AND GRIP ARE SEPARATE

REDUCER COUPLINGS

Reducer couplings are adapters for standard bodies, making possible line reductions on any leg by use of standard adapters and adapter nuts.

. . . A Hacksaw And A File Are All You Need

Excessive wrench torque is unnecessary for seal does not depend upon tightness of the nut. The higher the pressure the tighter the grip. Solve your hydraulic piping problems the easy way . . . with ease of assembly . . . no matching of exact tube lengths . . . simple leakproof connection for the life of the tube.

Reusable collet holds by friction grip up to bursting pressure of tubing.

LENZ FITTINGS MAKE THE JOB AS SIMPLE AS A B C

See our Catalog Page in Thomas Register 1956 Edition, Vol. 1, under classification "Fittings: Hydraulic" for complete list of types and sizes.

FOR MORE DETAILS, SEE PAGES 159-162 in the 56/57 Master Catalog of Fluid Power Products

LENZ COMPANY

BOX 1044-A • DAYTON 1, OHIO

PHONE: ORegon 9364 • 3303 KLEPINGER ROAD

DISTRIBUTORS IN PRINCIPAL CITIES

AIR CONTROLS . . . delivering clean, dry, lubricated air at the proper pressure, are detailed in Bulletin CU-20 released by The Bellows Co. Designated Lubri-Air Controls, a compelte unit consists of filter, air pressure regulator, gauge and lubricator.

Circle 224 on Reader Service Card

AIR STORAGE CYLINDERS . . . furnishing pressures up to 3000 psi are available from Walter Kidde & Co., Inc. Catalog gives information on the various cylinders and method of manufacture, along with a quick-reference chart for standard cylinder applications.

Circle 225 on Reader Service Card

FLEXIBLE METAL HOSE . . . and tubing manufactured by the American Metal Hose Division of The American Brass Company, is described in 64-page Catalog G-560. Booklet gives helpful design suggestions for fluid power engineers to plan flexible metal connector applications. Included are metal hose and tubing specifications, bend diameters, lengths, types, construction diagrams and descriptions of end fittings. Specifications are given on types of hose and tubing available, including bronze, brass, steel, stainless steel, aluminum, monel, super nickel, other metals and with certain plastics. A wide range of applications illustrates use on machine tools, mobile equipment, marine and industrial equipment.

Circle 226 on Reader Service Card

FLARELESS TUBE FITTINGS . . . for fluid power applications, are covered in 28-page Catalog 43-20 issued by Parker Appliance Company's Tube & Hose Fittings Division. Booklet includes a section on fittings for mounting in new SAE straight thread boss with O-Ring sealing.

Circle 227 on Reader Service Card

BOTTLE CART . . . for safe handling of high pressure air is described in a bulletin issued by Accessory Controls & Equipment Corp. Units are of rugged construction for safety in case of accidental rough handling, and are easily maneuvered by hand or tractor on an air field or in a factory.

Circle 228 on Reader Service Card

MINIATURE AIR CYLINDERS . . . valves, manifolds and fittings are produced by Clippard Instrument Laboratory, Inc. Bulletin describes a complete line of miniature pneumatic equipment for use in light production positions or new products. Units should be useful as miniature air vises and in automatic work feeding and assembly operations.

Circle 229 on Reader Service Card

BELT DRIVES . . . and roller chain drives for power transmission are available from Browning Mfg. Co. Bulletin GC-101-D gives specifications and information on their complete line of power-transmission equipment, including sheaves, bushings, flexible couplings, hubs and sprockets.

Circle 230 on Reader Service Card

HYDRAULIC CONTROL VALVES . . . manufactured by Dowty Equipment of Canada Ltd., are covered in 8-page catalog. Units feature sensitive actuation, totally enclosed mechanism, and may be used singly or in banked units. Available in sizes from ⅜ to 1-in., and operating over a pressure range up to 3,000 psi.

Circle 231 on Reader Service Card

FOUR-WAY VALVE . . . for double-acting hydraulic cylinders is manufactured by Monarch Road Machinery Co. Data sheet gives details on this 2½-in. valve for pressures to 2000 psi at 2 gpm.

Circle 232 on Reader Service Card

METALLIC SEALS . . . for high temperature and high pressure applications are illustrated and described in a bulletin issued by Skinner Seal Co. Seals are made from Inconel X and are re-usable. Multiple seals are available for special installations.

Circle 233 on Reader Service Card

AIR CONTROL VALVES . . . Dimensional data, parts list, descriptive information, price list and flow diagrams are given in the 71-page data file on the Starline series of air control valves manufactured by Ross Operating Valve Co. The Starline series is a group of five pilot heads which are interchangeable with seven valve bodies. Units are compact and lightweight.

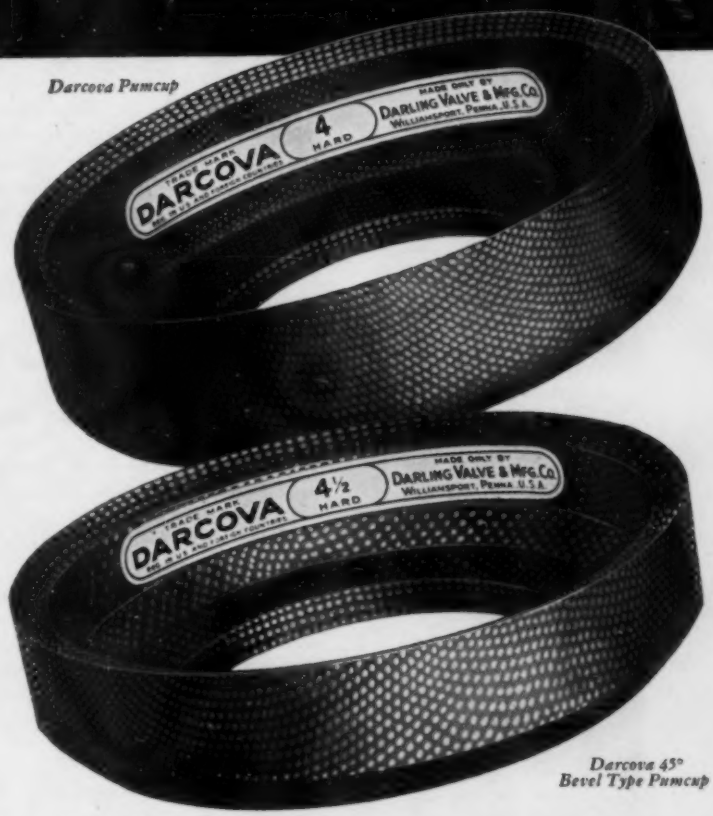
Circle 234 on Reader Service Card

DARCOVA PUMCUPS

now available with

100% NYLON COMPOSITION

for HYDRAULIC CONTROLS, AIR CYLINDERS, RECIPROCATING PUMPS



Darcova Pumcup

Darcova 45° Bevel Type Pumcup

DARLING Pumcups—long noted for unequalled efficiency and life in all kinds of cylinders—are now greatly exceeding their own performance records! The new 100% Nylon Composition, available *only* in Darcova Pumcups, does it!

Nylon Pumcups are made in sizes, types and textures exactly right for your particular equipment—ready *now* to give you unprecedented piston packing performance!

Write for helpful data Bulletin No. 5503.

DARLING VALVE & MANUFACTURING CO.

Williamsport 15, Pa.

DARCOVA THE ORIGINAL COMPOSITION CUP

TRADE MARK PUMCUPS

Post Scripts of Industry

News about people, manufacturers and sales organizations

George Tate
Vickers Inc.

John W. See
Tuthill Pump Co.

Laurent Oppenheim, Jr.
Greer Hydraulics, Inc.

Vickers Inc., has opened a regional sales and service office at Albertson, Long Island. Manager of the new facility is **George Tate.** Assisting him are application engineers **Walter Young** and **Fred Walker,** with **Lawrence Braithwaite** as sales coordinator.

Tuthill Pump Co., Chicago, Ill., appointed **John W. See** as regional sales manager. See will have charge of sales in New England, New York, New Jersey, and the eastern half of Pennsylvania, with headquarters at 30 Red Road, Chatham, N. J.

Baldwin Instrument Co. Ltd. announced inauguration of a fluid power division to control the sale and development of their pneumatic and hydraulic equipment. **D. A. Larner** heads this division.

W. S. Shamban & Co. announced the enlargement of their Culver City, Calif. plant and opening of their new plant in Fort Wayne, Ind.

Greer Hydraulics, Inc. announced election of **Laurent Oppenheim, Jr.** as chairman of executive committee of the board of directors. Other members of the committee are: **Fred M. Glass, Frederick F. Robinson,** and **Edward M. Greer,** ex-officio.

Parker Appliance Co., Cleveland, Ohio, appointed these four distributors: **Industrial Piping Supply Corp.,** 705 No. 22nd Street, Bessemer, Alabama, with **R. A. Patterson** as vice president and general manager; **Wencor, Inc.,** P. O. Box 391, Miami Springs, Fla., headed by **Hank Weaver; Abercorn Aero Ltd.,** 7435 Chester Avenue, Montreal, Can., with **Marion E. Baker** as president; and **Industrial Piping Supply, Inc.,** Pensacola, Fla.

Joseph M. Gentile was elected executive vice president of **Resistoflex Corporation,** Roseland, N. J. Completion of the new addition to the company's main plant at Roseland has resulted in doubling production capacity.

Fluid Regulators Corporation has moved to their new plant at 313 Gillette Street, Painesville, Ohio. The new facilities provide a 75 percent increase in production space.

Garrett Burgess, Inc., Detroit, Mich., was appointed distributor for **Fluid Controls, Inc.,** Mentor, O. Garrett Burgess, Inc. is located at 4660 Oakman Blvd., and will cover the lower peninsula of Michigan. **Donald J. Burgess,** president, appointed **John H. Bennett** as hydraulics division manager.

Continued on page 150

Circle 91 on Reader Service Card

PETCH-HUPP *Ring-Wedge Adapter*

STOPS PIPE THREAD LEAKAGE
without specifying straight thread

- Use with standard tapered female pipe threads
- No special tools required
- Tube end utilizes standard 37° Flare fitting elements
- RING-WEDGE male thread slotted allowing O-ring seal contact independent of port thread depth
- O-ring does not interfere with threads
- O-ring seals on port boss-spot face optional—no pipe sealing compound required

Part No.	Tube O.D.	Used w/ NPTF
821RW 6	3/8"	1/4"
821RW 6-6	3/8"	3/8"
821RW 8-4	1/2"	1/4"
821RW 8	1/2"	3/8"
821RW 8-8	1/2"	1/2"
821RW 8-12	1/2"	3/4"
821RW 10	5/8"	1/2"
821RW 12	3/4"	3/4"
821RW 14	7/8"	3/4"
821RW 16	1"	1"
821RW 20	1 1/4"	1 1/4"
821RW 24	1 1/2"	1 1/2"
821RW 32	2"	2"

Send for complete information

PETCH SALES—463 York, Detroit 2

PLANT—Alpena, Michigan **MANUFACTURING COMPANY**

J.I.C.
IN-LINE
3-WAY
SOLENOID
VALVES

$\frac{1}{4} \cdot \frac{3}{8} \cdot \frac{1}{2} \cdot \frac{3}{4} \cdot 1 \cdot 1\frac{1}{4}$

- NORMALLY CLOSED OR OPEN
- CONTINUOUS DUTY SOLENOIDS
- MOST A C & D C VOLTAGES

Write for Bulletin—Prices

COMPLETE LINE OF
Air Control Valves by
AUTOMATIC VALVE CO.
37415 GRAND RIVER AVE • FARMINGTON, MICH.

POWER *by* POWER JACKS

★ **HYDRAULIC PUMPS of proved efficiency for hand or power operation**

A MEMBER OF THE NEWTON GROUP

TECHNICAL DATA

Normal operating pressure . . 1,500 lbs. sq. in.

Maximum operating pressure (Blow off) . . 2,500 lbs. sq. in. (*or to specification*)

Output complete stroke . . . . . ·825 cu. ins.

Effective piston area . . . . . ·600 ins.

Handle leverage ratio 16-1

Alternative fluid capacities in pints . 2¾ pts., 6 pts., 16 pts., 24 pts., 32 pts.

Larger capacities to special order.

Vertical or horizontal pump handle.

JACKS from 1 TON to 5 TONS in a variety of stroke lengths

Send for illustrated technical brochure **Publication No.** F/223

POWER JACKS *LIMITED*
VALETTA RD·ACTON·LONDON·W.3·ENGLAND
TELEGRAMS: NEWSORBER, EALUX, LONDON, ENGLAND

 Circle 15 on Reader Service Card

Circle 93 on Reader Service Card

BELMONT
hydraulic packings

WATERPROOF FLAX

Belmont 300 Series Hydraulic Packing is constructed of the best quality line flax, braided solid, treated with a waterproof lubricant, firmly formed to size and surface graphited.

Ideal for heavy duty hydraulic services such as accumulators, rams, presses, plunger pumps on cold water, oil.

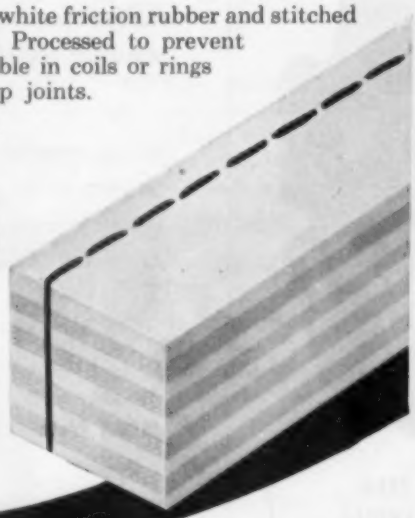
Supplied in 3 grades—hard, soft, very soft. And in coil, spiral or rings with butt joints.

WHITE FRICTION

Belmont Series 10 Hydraulic Packing is constructed to withstand hard service on inside-packed pump pistons and as end rings on plungers and rams in combination with other packings such as Belmont Series 300 shown above. For hot or cold water and oil.

Made of fine sheeting and white friction rubber and stitched with strong linen thread. Processed to prevent excessive swelling. Available in coils or rings with butt, bevelled or step joints.

Write for Catalog No. 56.



ask your BELMONT Distributor

such leading Packing Distributors as:

Manning Packing & Supply Co. in Portland, Oregon
and
Harry P. Leu, Inc. in Orlando and Miami

are ready to serve you promptly and helpfully, wherever you are.

The Belmont Packing & Rubber Co.
Butler & Sepviva Sts., Phila. 37, Pa.

BELMONT

Post Scripts of Industry
continued

M. Raymond Whigham was promoted to advertising and sales promotion manager of **The Allen Mfg. Co.**, Hartford, Conn.

Henry V. Heuser was elected president of the **Henry Vogt Machine Co.**, succeeding his father, **G. A. Heuser,** who became chairman of the board.

Henry V. Heuser
Henry Vogt Machine Co.

U. S. Hoffman Machinery Corporation announced the appointment of **Lloyd B. Duntley** as marketing executive for the industrial divisions and foreign operations.

Lloyd B. Duntley
U. S. Hoffman Machinery Corp.

Simmonds Aerocessories, Inc., Tarrytown, N. Y., and **Parker Appliance Co.**, Cleveland, Ohio, announced that **Simmonds** and **Parker Aircraft Co.**, Los Angeles, Calif., will manufacture and sell the selector and on/off valves of the **Saunders Valve Co.**

Winners of **Airmatic Valve, Inc.'s** $10,000 industrial sales contest received their awards at a national sales meeting held at the Cleveland Engineering Society. The meeting was held in connection with the Sales Engineers Division of the Society. Reading from left to right: Jack Catching; **Lawrence Gardner,** president of Airmatic; John Riffle; Everett Fieber; Robert H. Montgomery, Jr.; and Harry Jones.

Continued on next page

L. G. Martial was promoted to sales manager at **Axelson Mfg. Co., Division of U. S. Industries, Inc.,** Los Angeles, Calif.

Roylyn, Inc., Glendale, Calif., announced formation of **Airaterra,** a new corporation which will handle sales and service of Roylyn products as well as those of other manufacturers. **Donald L. Leavitt,** former president of Roylyn, was elected president of Airaterra. **N. Heath McDowell** was made general sales manager.

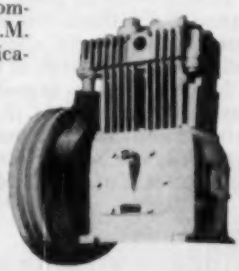
N. Heath McDowell
Airaterra

Glenn A. Walters was named a vice president of **Dalmo Victor Co., Division of Textron, Inc.,** Belmont, Calif.

A. E. Douglass, president of **Fuller Co.,** was named board chairman. **Channing O. Davis** was elected to succeed Douglass as president. **G. K. Engelhart** was named president of **Sutorbilt Corp., of California,** a Fuller subsidiary.

FOUR CONNECTING RODS are milled at both ends on this vertical mill equipped with two air-operated fixtures. Instead of clamping the work by hand, the operator has only to put it into position, and turn the valve handles. Each end of the rod is clamped separately. LOW-COST AIR POWER supplied by a Quincy Compressor operates the clamps. When the work is done, valves are turned again and rods are released, chips are blown away.

There are dozens of ways in which manufacturers are using Quincy Compressed Air to increase the efficiency of machines and manufacturing operations. Quincy makes compressors for industry from 1 to 90 C.F.M. For help with your compressed air applications, address Dept. AH-47.



Quincy COMPRESSORS

QUINCY COMPRESSOR CO. • QUINCY, ILLINOIS

Circle 96 on Reader Service Card

Circle 31 on Reader Service Card

ON THE JOB . . .
WITH CROSS

HYDRAULIC CYLINDERS

Four powerful CROSS HYDRAULIC CYLINDERS provide force for raising, lowering, and controlling shovel on this TWO-WAY LOADER—built by HOWRY-BERG Steel & Iron Works, Inc., Englewood, Colorado.

ATTENTION: O. E. M.

For better quality, and rugged, dependable performance...rely on CROSS! Our Engineering Department will be glad to work with you on design specifications, without charge. And, we can offer O. E. M. immediate delivery on any quantity, at a reasonable price.

This versatile design lends itself to all applications.

Illustrated catalog sent on request

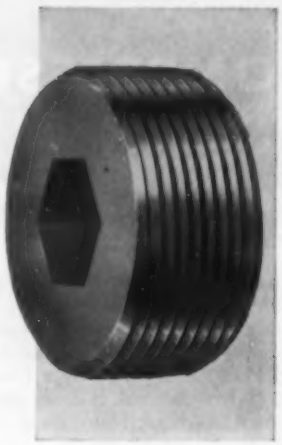
CROSS MANUFACTURING CO.
LEWIS, KANSAS — PHONE 86
WRITE • WIRE • PHONE

Post Scripts of Industry continued

Frank Flick (center), president of **Flick-Reedy Corp.**, Melrose Park, Ill., and **Wally Zelenka** (right), plant safety supervisor, receive plaque for safety record of its **Miller Fluid Power Division.** Presenting the award is J. E. Farr, manager, engineering department of Employers' Group Insurance Companies, which cited the firm for its record of more than 700,000 man hours worked without a lost time accident. The award is the second received in less than a year by the company.

specify standard UNBRAKO

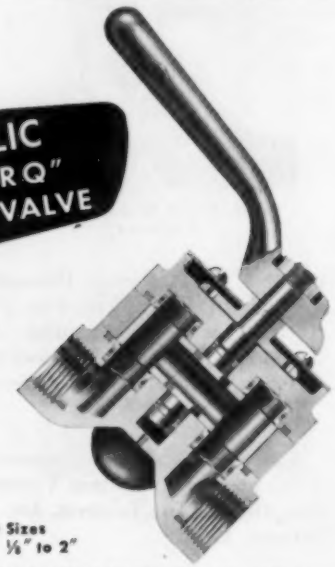
Dryseal-thread Pressure Plugs for hydraulic or fuel systems



Use them wherever liquids or gases must be contained under pressure—or in place of ordinary pipe plugs. UNBRAKOs seal without compound. They are made of the same high-strength alloy steel, have the same internal wrenching feature as UNBRAKO socket screws. Fully formed threads exceed NPTF specifications. Standard sizes—⅛ to 1¼ in.—are stocked by your authorized industrial distributor. See him for details. Or write Unbrako Socket Screw Division, STANDARD PRESSED STEEL Co., Jenkintown 2, Pa.

UNBRAKO SOCKET SCREW DIVISION
STANDARD PRESSED STEEL CO. SPS JENKINTOWN PENNSYLVANIA

REPUBLIC "LO-TORQ" SELECTOR VALVE



- 0-6000 psi service
- Low turning torque
- Panel mounting
- Semi-steel, bronze, aluminum alloy
- Zero leakage
- 3 types of portings
- Sizes ⅛" to 2"

Write for new catalog No. 654A for complete information.
Distributors in principal cities coast to coast.

201

RM REPUBLIC MANUFACTURING CO.
15655 BROOKPARK ROAD • CLEVELAND 11, OHIO

Circle 111 on Reader Service Card

Circle 99 on Reader Service Card

Jerguson Gage & Valve Co., Burlington, Mass., has moved into its new plant and general offices on Adams St. The new facility contains twice the floor area of the former plant in Somerville, Mass.

Denison Engineering Div., American Brake Shoe Co., Columbus, O., promoted **Paul D. Norris** to vice president and general manager, and **Denison Neale** to director of sales.

Paul D. Norris
Denison Engineering Div.
American Brake Shoe Co.

Denison Neale
Denison Engineering Div.
American Brake Shoe Co.

U. S. Gauge Division of American Machine and Metals, Inc. has announced additions to sales personnel at the factory and some branch offices, including a new office at Dallas, Tex., where **William H. Bolton** is in charge. Added to other offices were the following: **Donald Zook,** Houston; **L. R. Muha,** Chicago; **R. W. McWatters,** Cleveland; **C. F. David,** Los Angeles; **J. H. Moore,** at the factory in Sellersville, Pa.

Continued on next page

FILTRATION *Engineered* *TO MEET INDUSTRY'S NEEDS

CUNO

The ONLY Line that offers You Several Distinct Types of filter Media . . . The RIGHT Choice for Every Requirement

AUTO-KLEAN

METAL EDGE TYPE

Continuously cleanable. Combine small size, high flow rates and low pressure drop. A wide range of models and sizes with capacities to 4000 gpm and filtrations as fine as 40 microns.

FLO-KLEAN

WIRE-WOUND

For low-viscosity, high volume (up to 15,000 gpm) filtration. Filtration from .0025" to .030". Filters are completely automatic, continuously self-cleaning without loss of backwash fluid.

MICRO-KLEAN

FIBER CARTRIDGE

New white cellulose cartridge for 5-micron filtration wherever clarity, purity and taste are essential. Wool cartridge for a wide range of 10 to 70 micron applications including compressed air. Housings for flow rates from a few gph to hundreds per minute.

PORO-KLEAN

POROUS STAINLESS STEEL

Cartridges and special forms. Combine extreme heat and corrosion resistance, high tensile strength and very fine filtration (down to 5 microns, standard). Tests prove no contamination from particle discharge.

*Because no *one* type of filter is best for every need, Cuno — and *only* Cuno — offers you a truly complete line that includes *several* distinct types of filtration media. And because every filtration system must be specified and engineered to the individual job requirements, Cuno also offers you a complete application engineering service through the Cuno Systems Engineer. Conveniently located in your area, one of these specialists is ready and qualified to help select the filter type and model exactly right to solve your problems.

SEND FOR FREE PRODUCT LITERATURE

CUNO ENGINEERING CORPORATION

204 SOUTH VINE STREET, MERIDEN, CONNECTICUT
TELEPHONE: BEverly 7-5541

Filtration Engineers — **EDGE-TYPE, WIRE-WOUND, FIBER CARTRIDGE and POROUS METAL FILTERS** — *in Principal Cities*

Circle 32 on Reader Service Card

Post Scripts of Industry
continued

Ledeen Manufacturing Co., El Monte, Calif., appointed **Harold Rosoff** as sales manager. **James E. Dyer Co.** of Tulsa, Oklahoma was named as representative.

Schroeder Brothers Corp., representatives for **Rivett Lathe & Grinder, Inc.,** has moved to their new location at Box 72 Nichol Ave., McKees Rocks (Pittsburgh), Pa.

Crane Packing Co. Morton Grove, Ill. purchased a one-story plant in Vandalia, Ill. The 30,000 sq. ft. facility was placed in operation almost immediately. The Vandalia plant will be used to augment the manufacturing facilities of the home plant.

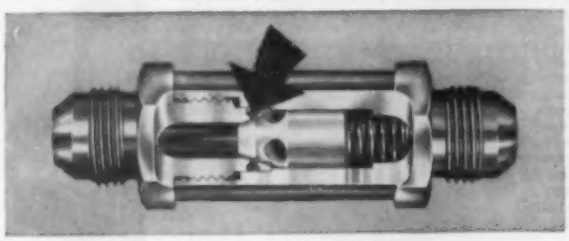
Six appointments were made in the sales department of **Ross Heat Exchanger Div. of American-Standard,** Buffalo, N. Y., as follows: **Paul W. Wilcox,** sales manager; **George G. Van Tuyl,** manager of power equipment sales, eastern region; **Marvin F. Schobert,** product manager, standard exchangers; **Richard J. Riedl,** product manager, engineered, Navy and Atomic exchangers; **Lawrence M. Fletcher,** product manager, feedwater heaters; **William G. Ritchie,** product manager, surface condensers and ejectors.

Announcement has been made of the formation of **A. U. Stone & Co.,** 23 West 60th St., New York City. The company designs and produces hydraulic components for aircraft and industrial use. Heading the company is **Allan Stone,** formerly chief engineer and a director of Gar Precision Parts, Inc.

Continued on page 156

Simple, Secure . . . Leak-Tight!

The **FLEXIBLE SEAL SEAT***



Responsive action of the soft O-ring seal provides absolute leak-tightness. Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts; no extra end seals. Stocked in 6 standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Write for data sheet.

KEPNER PRODUCTS COMPANY
7321 West 59th Street • Summit, Illinois

Kep-O-seal

HYDRAULIC & PNEUMATIC
CHECK VALVES

* PATENT APPLIED FOR

ELIMINATE NOISE-SHOCK!

NOW—You can silence your air-operated equipment *and step up worker efficiency . . .*

QUIETAIRE Pneumatic Silencers reduce sound in Noise-Shock areas close to the level found in the average factory (75 decibels). THAT'S IMPORTANT in terms of less worker fatigue—greater productivity—vastly improved morale. QUIETAIRES are small and compact; easily installed, easy to clean. Being all metal, they are rugged, durable, and safe: a lifetime product.

A new folder gives complete information. Write us to send you one!

"*PRODUCTION PROVEN*"

Quietaires have been produced for the automotive trade in Detroit since 1952. More than 25,000 have been manufactured and sold. C. W. Morris Company, the manufacturer, has produced over 350,000 units of noise dampeners of various design.

Quietaire PNEUMATIC SILENCER

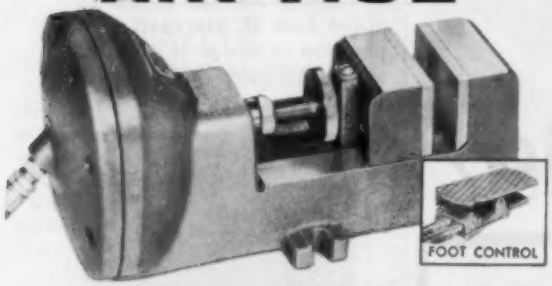
C. W. MORRIS COMPANY
10630 CLOVERDALE • DETROIT 4, MICHIGAN

Circle 63 on Reader Service Card

Circle 81 on Reader Service Card

Circle 23 on Reader Service Card

Speedy AIR VISE



HIGH SPEED · POWERFUL GRIP

New, improved model speeds up all repeat operations—*milling, drilling, tapping, punching, bending, riveting.* Both hands left free to produce more! Light squeeze to 2250 pounds pressure! Extra thick jaws for attaching jigs. Jaws open to 3-inches; 1/16" to 5/8" maximum travel. Complete with foot control, air hose and fittings..... **$44.00**

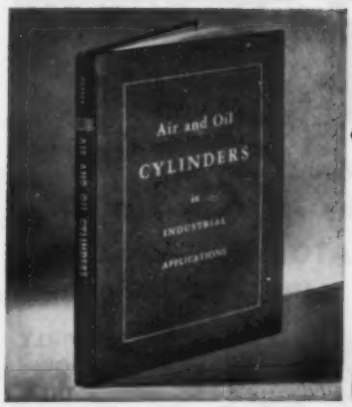
SPEEDY 1-TON AIR PRESS

Does the work of expensive presses! Power factor 15 times air line pressure. 3-inch throat; Ram 0 to 5"; stroke ⅝"; table 5" x 5". Operated by foot or fingertip controls. **$85.00**

Order from Your Supplier or Write for Air Tool Catalog

W. R. BROWN CORP., 2655 N. Normandy Ave., Chicago 35

AIR TOOLS • AIR VISES • AIR REGULATORS • FILTERS • COMPRESSORS



AIR & OIL CYLINDERS

Elmer Heiser has written this valuable cylinder handbook which tells about types, cushions, how to order, proper porting, correct sizing, packings, and efficient installation methods.

It's full of application ideas.

PRICE $5.00

The Industrial Publishing Corporation

812 Huron Road • Cleveland 15, Ohio

Palley's SAVE YOU UP TO 85%

on HYDRAULIC CYLINDERS - VALVES - PUMPS - PARTS, etc. . .

OVER 10 YEARS EXPERIENCE in filling the needs of Aircraft and Heavy Industry led to the development of our own line of outstanding INDUSTRIAL HYDRAULIC CYLINDERS and supplies. We also carry one of the largest stocks of GENUINE GOV'T SURPLUS CYLINDERS, VALVES, PUMPS, MOTORS and Accessories. What we cannot supply we will CUSTOM MANUFACTURE to YOUR specifications.

NEW Palley HYDRAULIC CYLINDERS

All are Double Action with rugged steel construction throughout. Made to stand pressures up to 1500 PSI and 3000 PSI. Utilizes standard 'O' rings in all models and has leather back-up rings in the 3000 PSI types.

PART NO.	BORE	STROKE	SHAFT	P.S.I.	PRICE
P3-4-15E	3"	4"	1-1/8"	1500	$34.25
P-6-15E	3"	6"	1-1/8"	1500	36.75
P3-12-15E	3"	12"	1-1/8"	1500	44.75
P4-5-15E	4"	5"	1-1/8"	1500	39.50
P4-8-15E	4"	8"	1-1/8"	1500	45.75
P4-5-30E	4"	5"	1-1/2"	3000	55.25
P4-8-30E	4"	8"	1-1/2"	3000	61.50
P4-12-30E	4"	12"	1-1/2"	3000	69.75
P5-12-30-1	5"	12"	2"	3000	85.00
P5-24-30-1	5"	24"	2"	3000	115.00

SPECIAL GOV'T SURPLUS HYDRAULICS

40,000 LB. THRUST CYLINDER

A GOV'T SURPLUS BARGAIN! Produces up to 40,000 lb. thrust with a 3000 PSI line pressure. May also be used as a low pressure air cylinder. Has 4" bore, 18" stroke. 30½" long. Navy overhauled— LIKE NEW — **49.95**

VICKERS PISTON TYPE PUMPS

Made to top Aircraft specifications. RPM given below is recommended for constant speed.

PF9-713-20BCE — Delivers 5.3 GPM at 1000 PSI at 3000 RPM — USED **$20.00**

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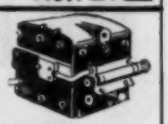

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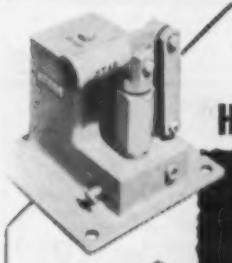

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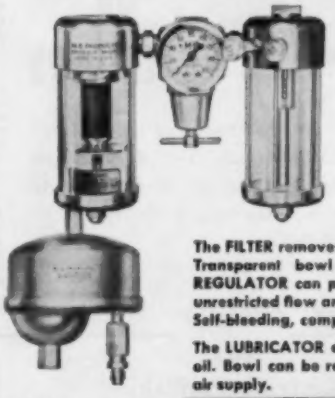

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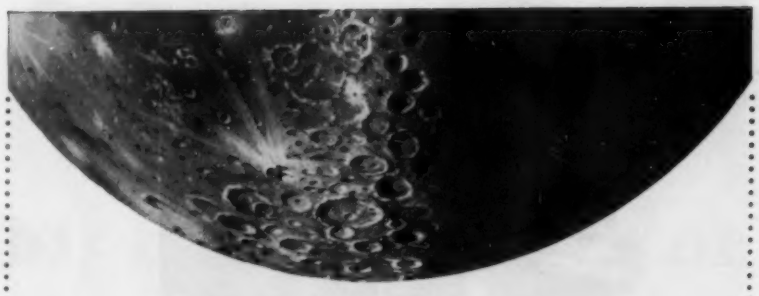

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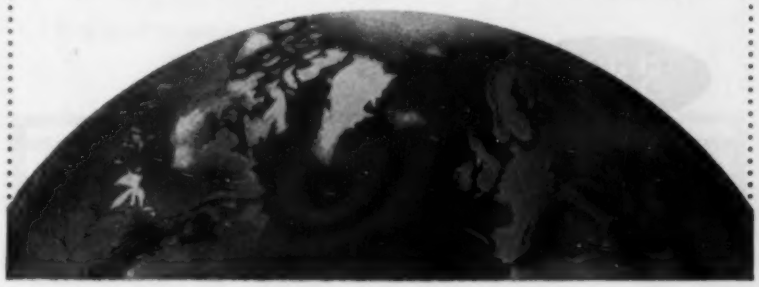

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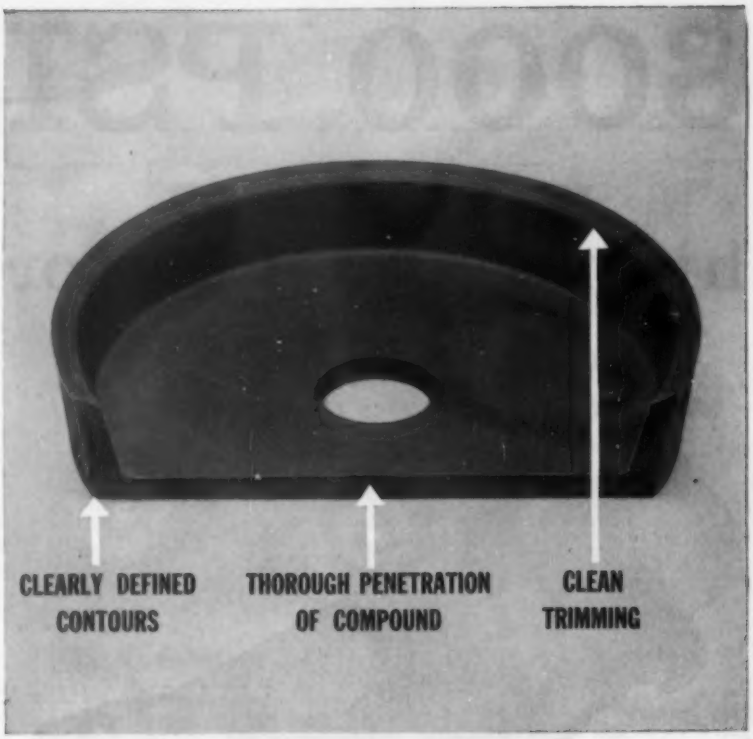

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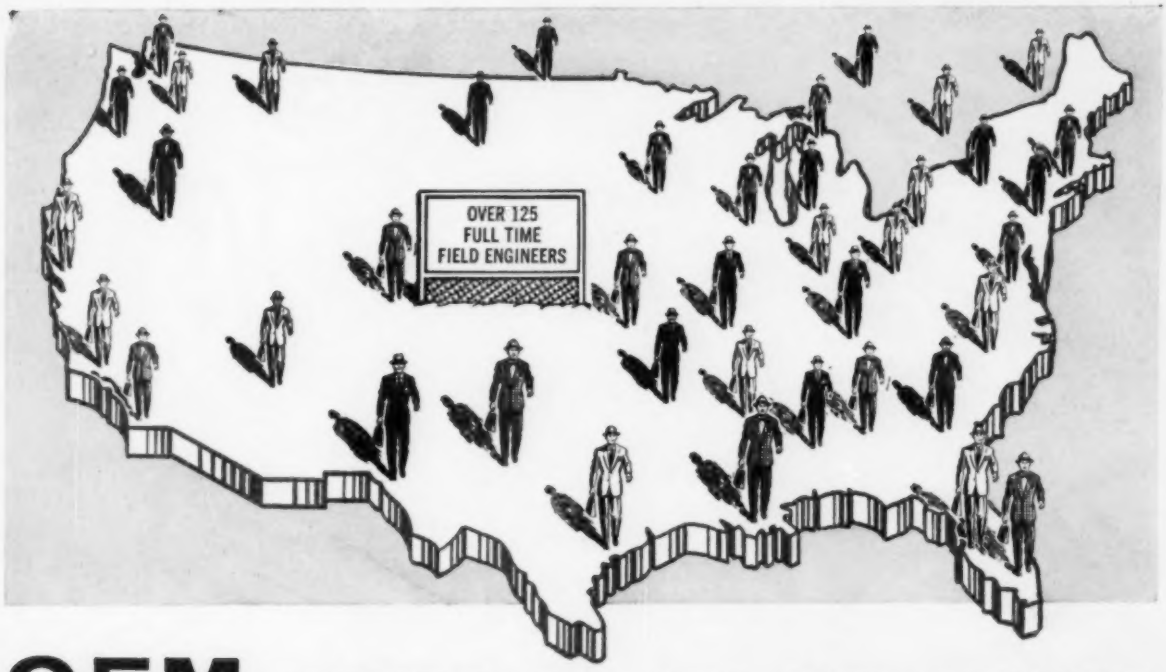

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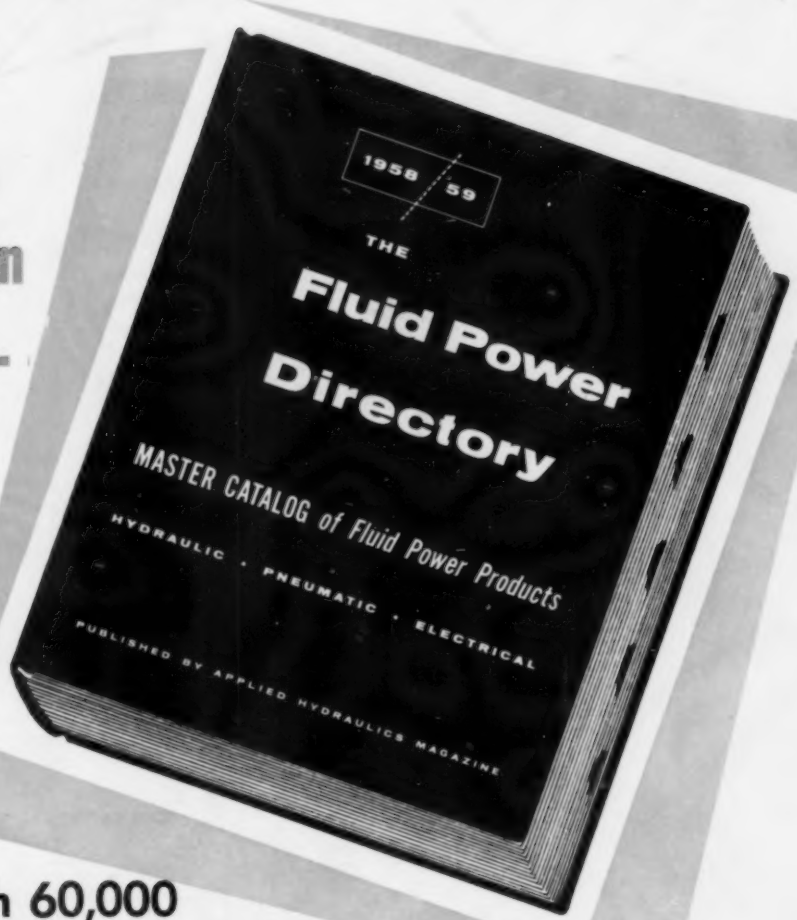

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